University of Canterbury

Honours Thesis

Black Soldier Fly BSFL to Create Value from Biosolids

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Abstract

Globally, 10s of millions of tonnes of biosolids are produced annually. Their disposal is expensive and environmental damaging. The composition of biosolids, which contain high concentrations of nutrients and organic matter, could make them a potentially valuable commodity for products such as soil conditioners. However, reusing biosolids is limited by heavy metals (HMs) such as Cu and Zn, which may accumulate in soils. Black Soldier Fly larvae (BSFL). have shown potential in previous studies to be used as a solution to process biosolids and other biowaste, such as food wastes. There is a gap of information on how BSFL interact with heavy metals in biosolids as well as biosolids blended with biowastes.

The aim of this research is to determine whether BSFL partition chemical elements, while surviving on biosolid Substrates. The methods used to do this included the analysis of total-extractable elements, $Ca(NO_3)_2$-extractable elements, Flow injection analysis, and Carbon-Nitrogen analysis. Bioaccumulation Factors, chemical mass balance, and protein content was also calculated.

The results indicate BSFL partition most potentially toxic HMs from Substrates into Residue and the BSFL itself. Excreta and BSFL showed significant differences compared to Substrate chemical concentrations. The high-value biomass with low HM concentrations could be used as a soil conditioner, animal food, or perhaps even processed for human consumption.

Future research should determine how each diet changes the BSFL elemental composition. Experiments may also reveal whether how BSFL reduce pathogen loads. This will be critical for the process to be upscaled to a commercial level. Finally, sociological and ethical questions should be addressed e.g. the acceptability of allowing BSFL to consume biosolids, which will then be used as animal feed.

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1 Introduction

By 2050, the human population will be an estimated 9.7 billion (United Nations, 2019). Such a large population will require an increase in global food production, resulting in more biological wastes including biosolids, the solid portion of treated sewage sludge.

Globally, 10s of millions of tonnes are produced annually. Most of this requiring excavation of valuable land to be stored (Mohajerani et al., 2019).

Solutions focusing on sustainably managing waste to reduce organic matter, with the intention of diverting it into useful production of other food and energy sources will be necessary in the future. This is the core idea of circular economies, which aims to keep resources in the cycle of use for as long as possible, maximizing its usage, then recovering as much material as possible at its end-of-life. This material could be used to create more products which contribute to a circular economy (Ministry for the Environment, n.d.).

Insect farming using biosolids may enable recycling waste usually disposed of in a linear economy system. A promising insect to do this is *Hermetia illucens*, commonly known as the Black Solider Fly (BSF). When in their larval stage, they can consume up to four times their body weight of organic matter (200 mg) a day, but their ability to do so depends on the biowaste composition (Diener, Solano, Gutiérrez, Zurbrügg, & Tockner, 2011; Diener, Zurbrügg, & Tockner, 2009; Liu, Minor, Morel, & Najar-Rodriguez, 2018; Tomberlin, Sheppard, & Joyce, 2002).

Decomposing organic matter, including human and animal effluent, is responsible for generating large quantities of ammonia, volatile organic compounds, and other greenhouse gases such as methane and nitrous oxide, which are associated with health risks and are partly responsible for smog in urban areas (Montero-Montoya, López-Vargas, & Arellano-Aguilar, 2018). Beskin et al. (2018) showed Black Soldier Fly Larvae (BSFL) can reduce these emissions by using otherwise decomposing organic matter as a food source. The BSFL could also be used as soil conditioner and food for animals or even food for humans.

1.1 The biology of the Black Soldier Fly

The BSF is a hardy insect, thriving in many environments, and surviving on a range of Substrates (Dortmans, Diener, Bart, & Zurbrügg, 2017). The BSFL do not have a restrictive diet

and feed on any decaying organic matter and manure in nature (Stefan Diener et al., 2009; Nguyen, Tomberlin, & Vanlaerhoven, 2015). The BSF is found in warm climates and can tolerate a temperature range of ~24-40°C, with 27°C shown to be optimal for BSFL. Depending on the nature of their environment and diet, BSFL convert low value biomass into high protein (35-50%) and oil (17-36%) (Purschke, Scheibelberger, Axmann, Adler, & Jäger, 2017).

There are four stages in the BSF lifecycle (Figure 1). The adult BSF hatches and after 48 hours can begin mating. After nine days, female BSF produce around 500 eggs near or in organic matter. After four days, BSFL hatch from the eggs and spend the next 14-18 days consuming as much organic matter as possible (Coudron, Spranghers, Elliot, & Halstead, 2019). The adult BSF survives on the fats acquired from its BSFL stage as they do not develop any mouth parts. Once sufficient feeding has occurred BSFL enter their pre-pupae stage. The BSFL relocate to a dry area where pupation (metamorphosis) takes place. Under favourable conditions this lasts two weeks before an adult soldier fly emerges , beginning the cycle again (Ferrarezi, Cannella, Nassef, & Bailey, 2016).

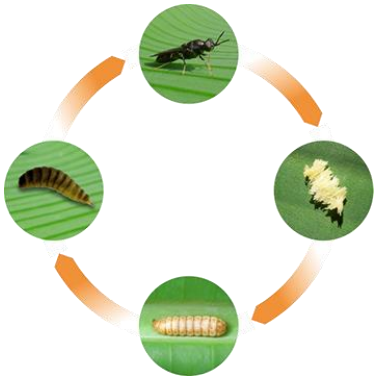

Figure 1. The lifecycle of the BSF illustrating the progression from egg to fly (Entofood, 2016).

1.2 Knowledge Gap

A knowledge gap exists on the use of BSFL to treat biosolids blended with other biowaste, while tracking how chemical elements are partitioned from the Substrate (food), Rs (excreta), and the BSFL.

Most studies have focused on how BSFL treat strictly human and animal manure diets, with a specific focus on Heavy Metals (HMs) (Wu, Wang, Xu, Cai, & Xie, 2020). Results have reported large differences in survival rates (40-91%) (Lalander, Diener, Zurbrügg, & Vinnerås, 2019), BSFL weight (70-299 mg) (Nyakeri, Ogola, Ayieko, & Amimo, 2017), and differences in HM partitioning when fed biosolids. Some of which observed indication of toxic HM using a bioaccumulation coefficient (BAC), where values >1 indicate bioaccumulation is occurring in the BSFL (Cai, Hu, et al., 2018) while values <1 indicate no bioaccumulation is occurring in the BSFL (Proc, Bulak, Wiącek, & Bieganowski, 2020). Understanding how biosolids blended with

other biowaste and how well BSFL perform when processing these blends will provide insight into how different Substrates could be blended to optimize this process on a larger scale, should blending biosolids prove successful. Evidence has suggested BSFL have the ability to grow desirably with blends, but how partitioning is affected is unclear (Barragán-Fonseca, 2018; Gold, Tomberlin, Diener, Zurbrügg, & Mathys, 2018)

1.3 Literature Review

BSFL have been well researched for the purposes of creating high value fats and proteins from food sources of reasonable quality with the potential to feed livestock and potentially humans (Bessa, Pieterse, Marais, & Hoffman, 2020; Paz, Carrejo, & Rodríguez, 2015; Wang & Shelomi, 2017). Some research has also investigated the feasibility of using BSFL to treat animal manure and biosolids (Awasthi et al., 2020; Cai, Hu, et al., 2018; Lalander et al., 2013). Investigation of using BSFL has commonly fallen upon several factors. These factors include BSFL performance, which includes BSFL survivability and BSFL growth on many Substrate types from Brewer's Grain to sewage sludge. Many studies have claimed differing results, showing the highly variability in performance of the BSFL.

According to Purschke et al. (2017), who investigated the bioaccumulation of several HMs, myotoxins, and pesticides found that there was no evidence of significant bioaccumulation or growth inhibition, with the only exception being for Cd and Pb. These HMs measured concentrations at 13.7 mg/kg and 35.6 mg/kg, respectively. Other studies have stated HMs accumulate in the body of BSFL and have effects on their weight and survivability, but not in the extractable oil of the BSFL (Cai, Hu, et al., 2018).

BSFL reduce Substrates at different rates depending on the composition. Reductions in food waste has shown to be ~55%, while fruit and vegetables, human faeces, and undigested sludge is lower (~47-49%). This does not reflect the bioconversion rates, where food waste (13.4%) is higher than fruit and vegetables (4.1%), human faeces (11.3%), and undigested sludge (2.2%) (Lalander et al., 2019). How Substrates are treated prior to feeding and the feeding rate has previously shown to cause high variability of the BSFL processing performance, particularly in biosolids (Nyakeri, Ayieko, Amimo, Salum, & Ogola, 2019).

BSFL have shown to convert C and nitrogen (N) from organic wastes into biomass (Pang et al., 2020). The remaining N has shown to largely separate from solid waste and is instead released as NH_4^+-N, NO_3^--N, NO_2^-, and gases. Nitrogen products depends on many variables such as Substrate composition, pH, temperature, HM content and microbiology (Krogmann & Woyczechowski, 2000). BSFL which feed on decaying organic matter have shown significant increases in inorganic nitrogen, largely in the form of NH_4^+-N, while significantly lowering NO_3^--N (Green & Popa, 2012; Lalander, Fidjeland, Diener, Eriksson, & Vinnerås, 2015). Sarpong et al. (2019) observed biowaste and biosolids treated with the BSFL may be used as compost for agricultural purposes due to oxidising organic carbon and significantly increasing N and P, key ingredients in fertilizers.

Nitrogen content has also been as a proxy to estimate protein for a range of bugs and has been used in several studies to do so. Although this may not as accurate as testing actual protein content it has shown to be reliable and is important when deciding on the use of products post-treatment (Gold et al., 2020; Janssen et al., 2017).

The content of HMs in the products produced (remaining Substrate, Residue, and BSFL is potentially the most important factor in their post-processing applications. The concentration of HMs is dependent on the Substrate used to feed BSFL. Although the HM content changes depending on pre-treatment, biosolids commonly contain high concentrations of undesirable HMs (Al, Cd, Cu, and Pb) (Gold et al., 2018), which has likely prevented its use in a large-scale commercial setting. Despite this, BSFL have shown to reduce the total concentration of HMs within the Substrate. Previous research has shown mixed results where BSFL did and did not experience increased concentrations (Cai, Hu, et al., 2018; Proc et al., 2020). Removal efficiencies of HMs from the Substrate were typically between 95-100% (S. Diener, Zurbrügg, & Tockner, 2015). If removal of HMs from treating any biowaste and biosolids results in harmful levels of bioaccumulation within the end products, they could spread to the environment depending on how the BSFL, Residue, and remaining Substrate are used and managed post-process.

Lastly, the benefit of using BSFL shown by other studies is the reduction of pathogens in animal effluent and biosolids which both contain dangerously high levels. The use of BSF to process biowastes has shown to be an effective waste treatment and reducer of pathogens in animal effluent as well as biosolids (Cai, Ma, et al., 2018; C. Lalander et al., 2013). This leads

to the question “Can BSF also provide the solution to safely and effectively treat biosolids?” Insects have previously been imported for biological control in New Zealand. An example being the release of 11 species of dung beetle to mitigate the effects of large mammalian manure. This technique has shown success in other countries including Australia where 23 species of dung beetle have been successfully established (Forgie, 2017).

Before establishing the BSFL as a full commercial solution and its ability to process Substrate pathogens safely, the concentrations and bioaccumulation of chemical elements with particular focus on HMs is paramount to investigate its feasibility on a commercial scale and claim its potential benefits in a circular economy system. The chemical composition of the Substrate, BSFL, and Residues are investigated in this project with a focus on HMs.

Hypotheses

1. Null Hypothesis: There will be no partitioning of the chemical elements between Residue and BSFL (which also include pupae).
2. BSFL can survive on Substrates containing biosolids mixed with Food waste and Wheat Bran.
3. Heavy metals in Substrates will be partitioned evenly between Residues and BSFL evenly (figure 2).
4. The Residues of the BSFL will contain suitable amounts of C, N, and P with some traces of HMs and will be useful for fertilising plants.

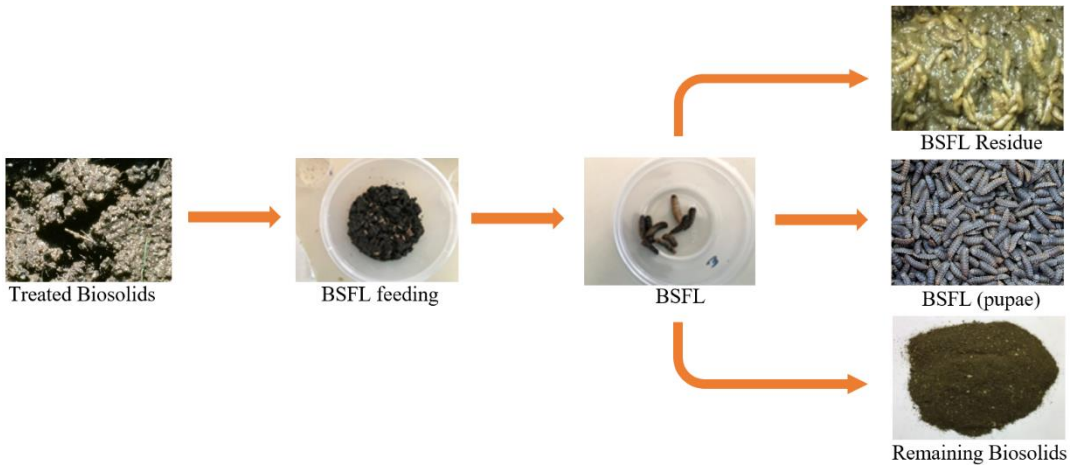

Figure 2. BSF treatment process, which also shows how HMs partition into BSF Residues, BSFL, and treated biosolids. Each end product will vary in composition depending on the initial Substrate composition and the effectiveness of the BSF feeding treatment. Photos of BSFL taken by Kristin Bohm (CentraSep Technologies, 2020; Cheng, Chiu, & Lo, 2017; Environmental Expert, 2019; The Happy Chicken Coop, 2019).

1.4 Aim of Research

The aim of this research is to investigate the feasibility of reducing and converting biosolids and biosolids blended with biowaste using the BSFL in the context of circular economies. It is the hope this research will contribute to the work being carried out at the Environmental Science and Research Institute (ESR), driving sustainable and evidence-based solutions for this area forward into the future.

2 Methodology

Section 2.1 of the methodology was carried out at Environmental Science and Research Limited (ESR) by Kristin Bohm. This included BSFL rearing, Substrate moisture content, measuring pH and EC, as well as the collection of the raw data in section 3.1. Once this was completed, samples were sent to the University of Canterbury where chemical (section 2.2) and statistical analysis (section 3) was completed (see Appendix B for statistical analyses).

2.1 Source of BSFL and feeding Substrate

10-day old BSFL were obtained from Prescient Nutrition Ltd. (Palmerston North, New Zealand). BSFL were kept on moist wheat bran Substrate at 13°C for about 2-5 days until experiments were started.

Treatment types included Wheat Bran, Food Waste (household), Biosolids 1, Biosolids 1 blended with Food Waste (50:50), Biosolids 1 blended with Wheat Bran (50:50), and Biosolids 2 blended with Wheat Bran (75:25). Each treatment type contained 680 BSFL, which fed on 1300 g of each Substrate for 21 days. Wheat bran feeding Substrate was always freshly prepared before every feeding by mixing the bran (Champion Professional Flour Food Bran, Champion Flour Milling Ltd., Auckland, New Zealand) with autoclaved deionized water (1:4 ratio). Saw dust (Timi pine bedding) was obtained from Petware (Auckland, New Zealand) and mixed with autoclaved deionized water (1:4 ratio). Food waste consisted of cuttings and peelings of fruit and vegetables (feijoas, banana, mandarin, pineapple, mango, kiwi fruit, cabbage, onion, zucchini, sweet corn, carrot, potato, tomato, cucumber, salad), grounded tea, rice, noodles, and chicken eggshells. It was blended and kept at 4°C till feeding to BSFL. Biosolids, particularly dewatered sludge (referred to as biosolids 1) and digester sludge (referred to as biosolids 2) were retrieved from New Zealand municipal wastewater treatment plants (WTTP) in Wellington and Palmerstone North, respectively. The sludge was kept at 4°C till feeding to BSFL.

2.1.1 Experimental design

The experiment was performed in plastic cups (11 cm height, 6 cm diameter) with perforated lids. 50 BSFL were reared on biosolids1 or Wheat Bran control Substrate at 27°C and 70-80%

relative humidity for 11 days. Every third and fourth day, Substrate with a feeding rate of 50 to 200 mg/BSFL/day was added and 10 BSFL were randomly selected to measure larval weight, which were returned afterward. After 11 days of incubation, BSFL were separated from Residues (processed substrate), washed, and weighed. Moisture content of Substrate was determined at the start and end of the experiment

2.1.2 Performance of BSFL on different Substrate

BSFL were reared at 25°C and 60-70% RH in squared plastic boxes (12 cm height, 16 cm length) closed by a lid with a 10 x 10 cm hole that was covered with a polyester cloth. Different blends of biowaste and biosolids were fed to BSFL (Table 1) every third and fourth day with a feeding rate of 100 mg/ BSFL/ day. To monitor moisture content, pH, and electrical conductivity (EC) samples of Substrate and Residues were taken at the beginning and end of the experiment as well as every third and fourth day.

2.2 Chemical analysis of Substrate, Residues and BSFL

2.2.1 Moisture content and dry weight

To determine moisture content 10-15 g of material was dried at 60°C for 72h.

To calculate moisture content (*M)* the following equation was used:

$$M = \left(\frac{Fw - Dw}{FW}\right) 100 \qquad (1)$$

Where *Fw* is the initial fresh weight before drying and *Dw* is the weight after drying

To calculate the dry weight, the following equation was used:

$$Dw = Fw\left(1 - \left(\frac{M}{100}\right)\right) \qquad (2)$$

2.2.2 EC and pH

EC and pH were analysed using an EC electrode (CON700, EUTECH Instruments) and pH (pH700, EUTECH Instruments) in 4 g of Substrate or Residues that were mixed with 10 ml autoclaved deionized water and incubated at room temperature for 18 h.

2.2.3 Total extractable elements (ICPMS)

The Substrates, Residues, and BSFL (samples 19 to 54) were dried at 60 °C for 72 hours until a constant weight was obtained. Subsamples (0.2 g) were weighed into 16mm x 125mm Pyrex glass vials stored in a polystyrene bin. Subsamples were pre-digested in 5 mL of concentrated nitric acid (HNO_3) (67%), vortexed for 10 seconds to homogenise subsample, and left overnight. The subsamples were digested at 260 °C using a Milestone Inc. UltraWAVE Single Reaction Chamber Microwave Digestion System. Milli-Q water (10 mL) was used to dilute 0.5 mL of the digested sample to reduce HNO_3 concentration below 10% as required for Inductively coupled plasma mass spectrometry (ICP-MS). Subsamples were analysed using an Agilent 8900 Triple Quadrupole ICP-MS.

To acquire the elemental concentration, the following equation was used:

$$C = \frac{(S-B)V}{W} \quad (3)$$

Where C is the concentration of the dried solid (mg/kg), S is the concentration of the dissolved sample (mg/L), B is the reagent blank (mg/L), V is the volume (incorporating any subsequent dilutions), and W is the sample weight (g).

2.2.4 Quality Assurance

The quality of the total extractable element analysis was assured by measuring 8 blanks, duplicate samples, and Bovine Liver certified reference material (CRM), Rice Flour 1568a CRM, Tobacco Leaves c2015/76210 CRM, and Tomato Leaves 1573a CRM. Concentrations of As, Co, Cu, As, Mo, and Cd were analysed by ICP-MS. Mean Recoveries ranged from 80 to 102%.

2.2.5 $Ca(NO_3)_2$-extractable elements

To determine the concentration of $Ca(NO_3)_2$-extractable elements, a $Ca(NO_3)_2$ extraction method was used (Blakemore, 1981). Sample (2.5 g) was weighed into centrifuge tubes. $Ca(NO_3)_2$ (11.8 g) was dissolved in 1 L of DIW, creating 1 M of $Ca(NO_3)_2$. $Ca(NO_3)_2$ (15 mL) was dispensed into the sample. Samples were loaded onto a GFL Overhead Rotator 3040 for 120 minutes. Sample was centrifuged for 5 minutes at 3500 rpm. Samples were filtered into 30 mL tubes using grade 42 Whatman paper. These were stored in a refrigerator until ICP-MS preparation was ready. An additional 15 mL of $Ca(NO_3)_2$ was added to high mass

samples (i.e Wheat Bran) which absorbed all liquid, initially preventing filtering. These samples were shaken to resuspend solids and centrifuged again. These were filtered using grade 42 Whatman paper and stored in a refrigerator for later use. Sample (0.5 mL) was pipetted into a new tube with 10 mL of HNO_3 (2%) and shaken. This was analysed using an Agilent 8900 Triple Quadrupole ICP-MS. Equation (3) was used to calculate the concentration of each element analysed.

2.2.6 KCl extraction

Fresh sample (4 g) was weighed and placed into 50 mL centrifuge tubes. KCl (2 M) was prepared, with 40 mL added to the subsample. Subsamples were loaded onto a GFL Overhead Rotator 3040 and mixed for one hour on 22 rpm per minute. The extracts were filtered into clean 50 mL centrifuge tubes through grade 42 Whatman filter paper. Extracts were frozen until required for analysis.

To determine the concentration of Nitrate Nitrogen (NO_3^--N), a colorimetric method described by Blakemore (1981) and Miranda, Espey, and Wink (2001) was used. Vanadium(III) chloride (VCl_3) (200 mg) was dissolved in 25 mL of 1 M HCl. This was filtered using a 0.45 µm syringe filter to remove remaining solids. 24 mg of N-(1-Naphtyl)ethylenediamine dihydrochloride (NEDD) was dissolved in 25 mL of Deionized water (DIW). 500 mg of sulfanilamide was dissolved in 25 mL of HCl (5%). A stock solution was diluted with 2 M KCl to produce standards with NO_3^--N concentrations of 0, 0.1, 0.2, 0.5, 1, 2, 3, and 5 mg/L.

Aliquots of 350 µl of sample, 350 µl of VCl_3, 150 µl of NEDD, and 150 µl of sulfanilamide were pipetted into a 1.5 mL semi-micro spectrophotometer cuvette, respectively for each subsample. Subsamples were kept in a dark cupboard at room temperature for 40 minutes. A UV-visible spectrophotometer (Cary 100 Bio, Agilent Technologies, US) was used to analyse samples individually at 540 nm. The standard solutions were used to create a linear regression, which was used to calculate the NO_3^--N sample concentrations.

To determine the concentration of Ammonium nitrogen (NH_4^+-N), a colorimetric method described by Mulvaney (1996), as used. sodium salicylate (3.91 g) and sodium nitroprusside (0.0625 g) were dissolved in 50 mL of DIW. NaOH (1.5 g) and K_2HPO_4 (5 g) were dissolved in 40 mL DIW. sodium hypochlorite (5 mL) was then added. pH was adjusted to 13 by adding NaOH. The solution was made to 50 mL using DIW. Na_2EDTA (0.6 g) was dissolved in 10 mL

DIW. A NH_4^+-N standard solution of 100 mg/L was prepared by dissolving $(NH4)_2SO_4$ (0.0471 g) in 100 mL DIW. The standard solution was diluted with KCl (2 M) to standards of 0, 0.5, 1, 2, 3, 5, 6, 7, 8, 9, and 10mg/L of $NH4^+$-N. Standard concentrations over 5 mg were produced to understand the displacement of the 5 mg standard on the linear regression.

650 µL of sample, 50 µL of EDTA, 200 µL of sodium-salicylate-nitroprusside, and 100 µL of hypochlorite were added to 1.5 mL semi-micro cuvettes, respectively. The samples were kept in a dark cupboard at room temperature for 120 min. Absorbance was read at 667 nm with a UV-visible spectrophotometer (Cary 100 Bio, Agilent Technologies, US). Standards and blank were used for linear regression, which was used to calculate the NH_4^+-N concentration in the samples.

To calculate the concentration of NH_4^+-N and NO_3^--N, the following equation was used:

$$C = \frac{(Abs - B)KCl}{W} \quad (4)$$

Where *Abs* is the absorbance and *KClV* is the volume of KCl (mL).

This specific method yielded lower results than expected. It is thought this is due to the reagents reacting with N during the period where samples were kept in a dark cupboard, which caused a pungent ammonium smell to accumulate. To reanalyse results, samples were sent to Lincoln University where subsamples were analysed using an Alpkem FS3000 twin channel Flow Injection Analyser.

2.2.7 Carbon-Nitrogen Analysis

To prepare the sample for Carbon and Nitrogen (CN) analysis, samples were ground up using a mortar and pestle and stored in 30 mL tubes at room temperature for later use. To determine the percentage of CN, A Leco CN828 analyser was used. An EDTA standard was used to determine the reliability of tested triplicates. Aluminium foil was placed in a balance connected to the Leco CN828. Sample (0.1 g) was weighed into the Aluminium foil. The sample was taken out and folded into a teardrop shape, re-weighed, and then loaded into the carousel of the machine for combustion analysis.

A standard curve was produced for N due to systematic/machine error by using Na_2EDTA and Al_2O_3. The Na_2EDTA Standards were made to concentrations of 0, 0.00727, 0.0146, 0.0293,

0.0586, 0.117, 0.234, 0.469, 1.88, 3.75, and 7.5 mg/kg. The results found with this method can be used to estimate the C/N ratio and the protein content of each Sample.

To calculate the C/N Ratio, the following equation was used:

$$CNR = Cs/Ns \quad (5)$$

Where *Cs* is the carbon percentage of the sample and *Ns* is the Nitrogen percentage of the sample.

To calculate the protein content (%), the following equation described by Janssen et al. (2017) was used:

$$P = Nc\ 4.67 \quad (6)$$

Where *Nc* is nitrogen content (%).

2.3 Ethics for Health and Safety

All animal ethics for the experiments were obtained through ESR. Standard UC procedures were used for handling biologically and chemically hazardous materials.

2.4 Statistics

Total chemical elements, Carbon, Nitrogen, $Ca(NO_3)_2$-extractable elements, and NO_3^--N and NH_4^+-N was analysed individually through two-way analysis of variance (ANOVA) with a Tukey's honest significant difference (HSD) post-hoc test (<0.05). BSFL recovery and Mean BSFL weight gain (mg) was analysed using a one-way ANOVA with Tukey's HSD post-hoc test.

These data were processed using SPSS statistics software. Due to the small sample collection for each treatment type (triplicates), the variance was assumed to be equal for each treatment and sample type.

3 Results

3.1 BSFL Survival and Growth of BSFL

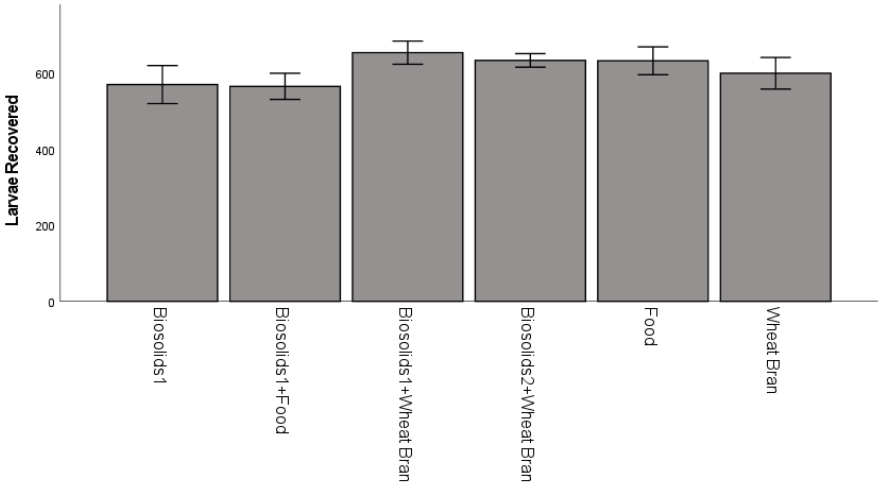

Figure 3. Mean number of BSFL recovered from each treatment type (mean ± SE, n=3).

Figure 3 shows there were no significant difference in the number of BSFL recovered across different treatment types. This indicates BSFL survive at similar rates, regardless of the differences in treatment types.

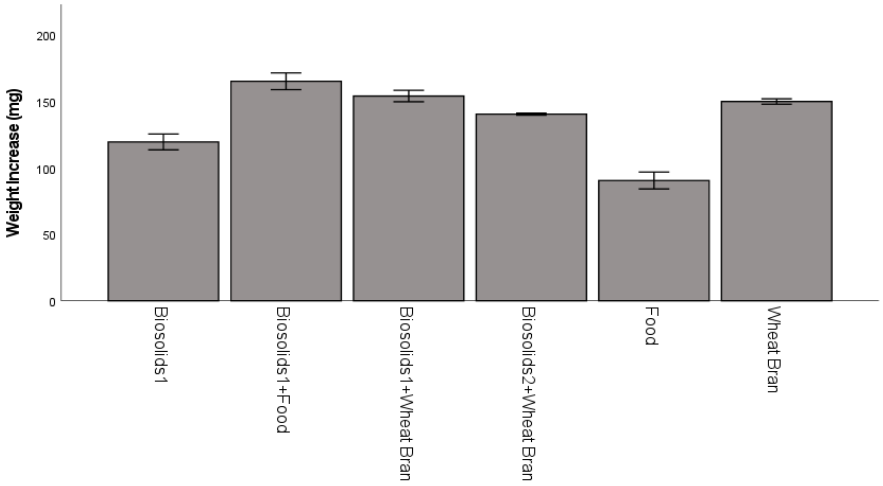

Figure 4. Mean weight increase (mg) of BSFL from each treatment type (mean ± SE, n=3).

Figure 4 shows Larval weight gain across treatment types had significant differences. Food had significantly lower weight gain compared to all other treatment types. Mixed Substrate treatment types and the Wheat Bran treatment type were not significantly different from one another. BSFL in the Biosolids1+Food treatment type had a significantly higher weight gain

compared to Biosolids2+Wheat Bran. This indicates BSFL generally experience a higher weight gain when fed on mixed Substrates.

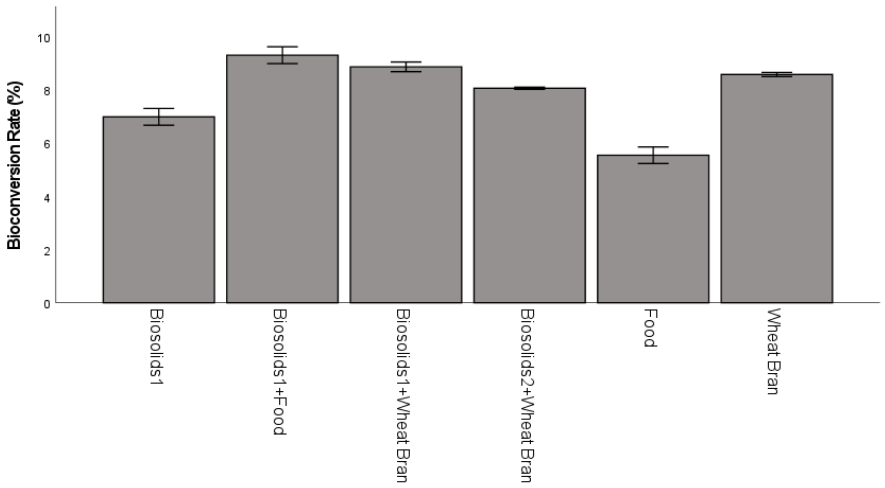

Figure 5. Bioconversion rates (% f.w.) of BSFL for each treatment type (mean ± SE, n=3)

Figure 5 shows similar results to the mean weight increase (mg) of BSFL from each treatment type. Food bioconversion rates were significantly lower compared to all other treatment types. Mixed Substrate treatment types and the Wheat Bran treatment type were not significantly different from one another. BSFL in the Biosolids1+Food treatment type had a significantly higher bioconversion rate compared to Biosolids2+Wheat Bran. This indicates BSFL generally have a higher bioconversion rate when fed on mixed Substrates.

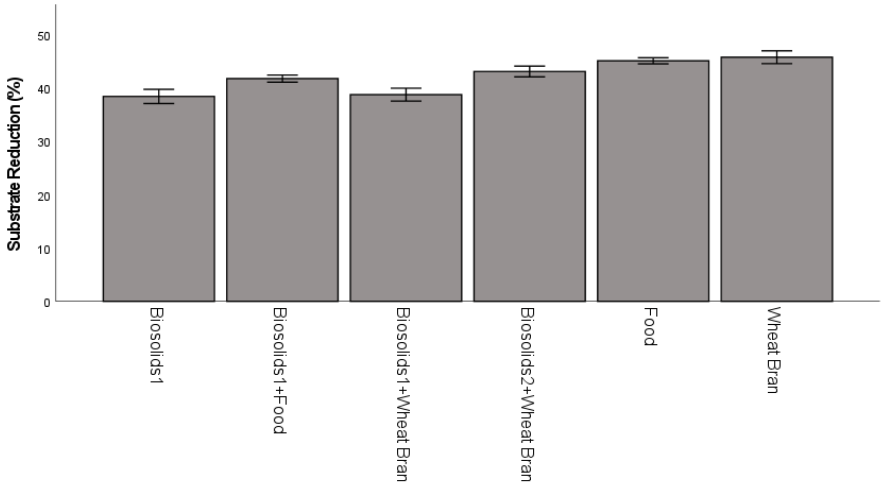

Figure 6. Substrate Reduction (% f.w.) of BSFL for each treatment type (mean ± SE, n=3)

Figure 6 shows that Biosolids1 was significantly lower than Biosolids2+Wheat Bran, Food, and Wheat Bran. Biosolids1+Wheat Bran was also significantly lower than Food and Wheat Bran.

3.2 Carbon and Nitrogen

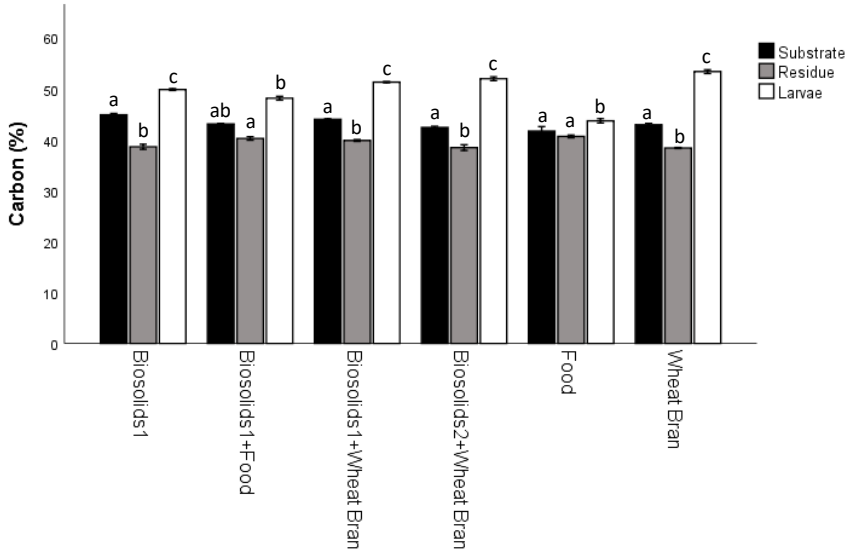

Figure 7. Mean C content (% d.w.) in the Substrates, Residues, and BSFL for each treatment type (mean ± SE, n=3).

Figure 7 Shows that in all treatment types except food, BSFL had a significantly higher C percentage than the Substrate, while Residues had a lower C percentage. Food Substrate did not have a significant difference to Residue or BSFL, while Residue and BSFL were significantly different. This result shows BSFL have an increased carbon percentage compared to the Substrate fed to them, except for Food where its ability to uptake carbon percentage is reduced.

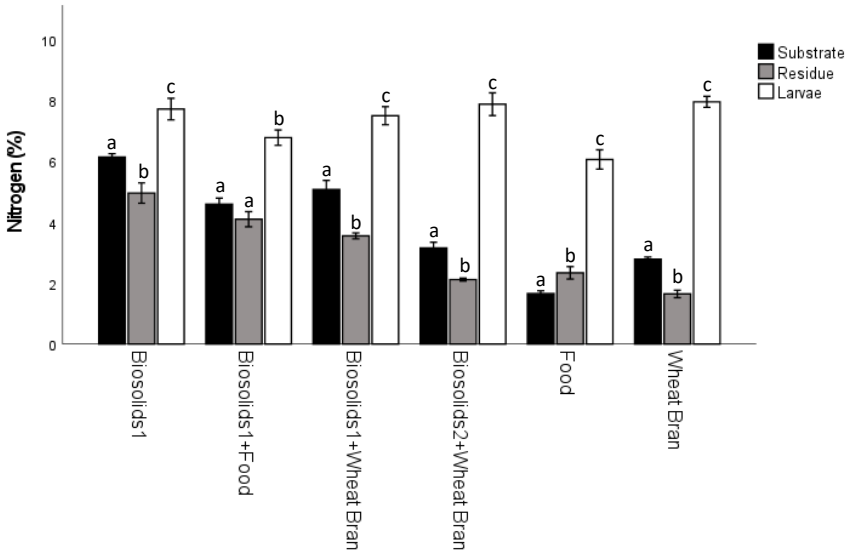

Figure 8. N content (% d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 8 shows that BSFL contain a significantly higher percentage of N across all treatment types compared to their corresponding Substrates and Residue. Except for the Food treatment type, Residues show a significant difference to the corresponding Substrate type and decreased in N (%).

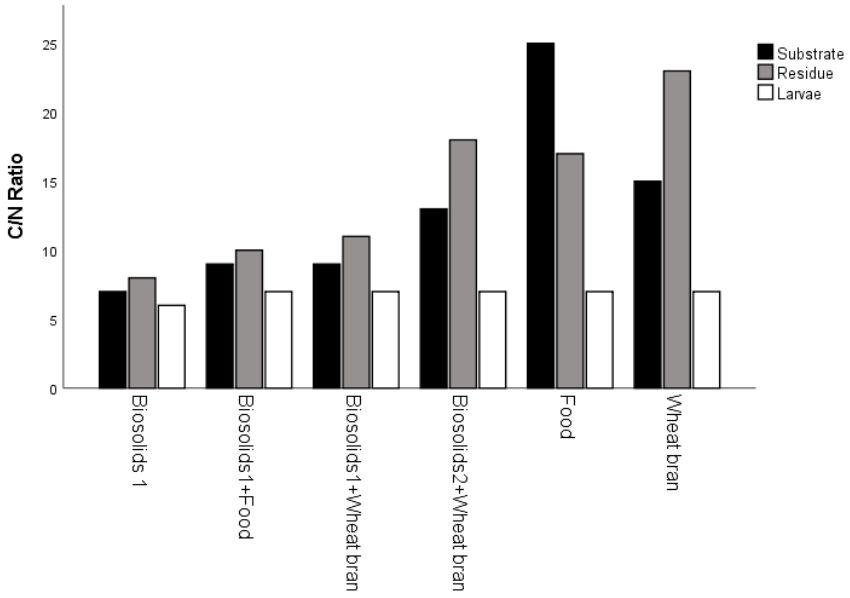

Figure. 9 C/N ratio for Substrates, Residues, and BSFL for each treatment type.

Figure 9 shows Substrates, Residues, and BSFL containing Biosolids1 had a lower C/N ratio compared to Biosolids2+Wheat Bran, Food, and Wheat Bran treatments. BSFL had the lowest C/N ratio, while Residue had the highest C/N ratio among all treatments except for the Food treatment where the C/N ratio Substrate was significantly higher than the Residue.

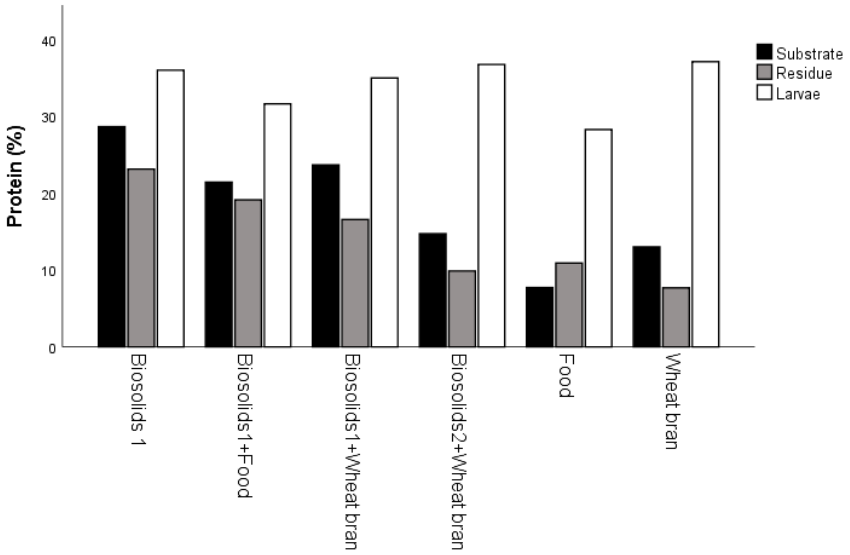

Figure 10 Protein content (%) calculated using the equation from Janssen, Vincken, van den Broek, Fogliano, and Lakemond (2017) based on N content (%).

Figure 10 shows Food and Food blended treatments had the lowest protein content. Wheat Bran had the highest protein content found in the BSFL sample type, despite having a low percentage of N. These results indicate BSFL typically contain higher protein content when fed biosolids (1 and 2).

3.3 Nitrate-Nitrogen and Ammonium-Nitrogen

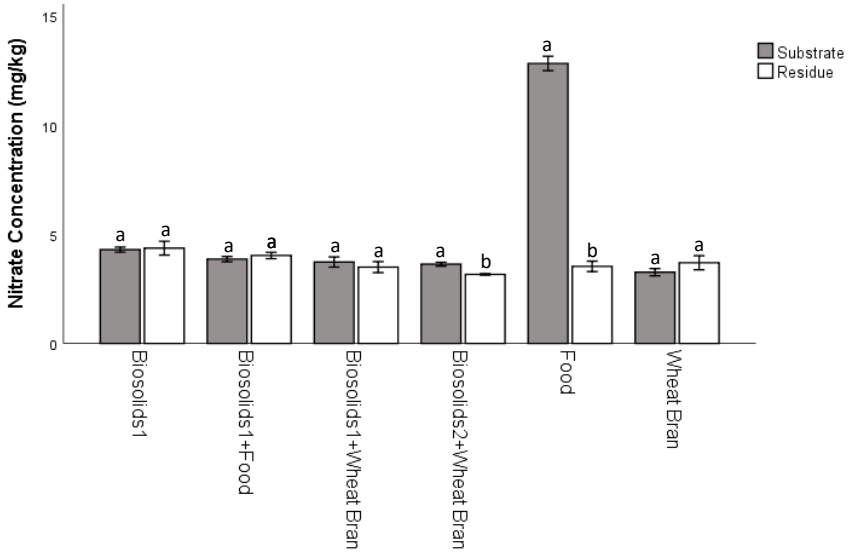

Figure 11. Mean concentrations (mg/kg) of NO_3^--N in the Substrates and Residues for each treatment type (mean ± SE, n=3).

Figure 11 shows NO_3^--N concentrations are similar across Substrates and Residues in all treatments except for Food Substrate. This has markedly higher concentrations compared to all other samples.

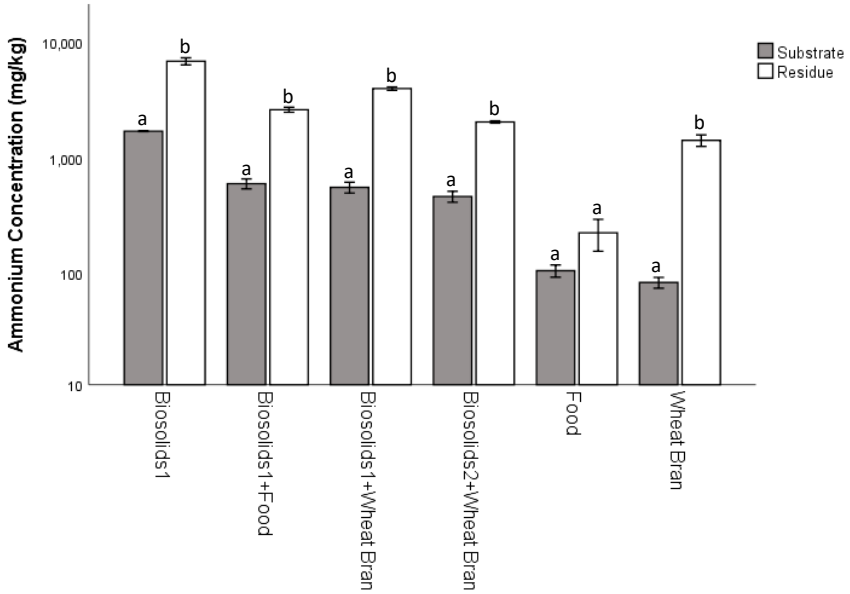

Figure 12 Mean concentrations (mg/kg) of NH_4^+-N in the Substrates and Residues for each treatment type (mean ± SE, n=3).

Figure 12 shows NH_4^+-N concentrations in Food treatment was minute and the Substrate and Residue did not have a significant difference. In the Biosolids1, Biosolids1+Food, Biosolids1+Wheat Bran, Biosolids2+Wheat Bran, and Wheat Bran treatment type, Residues had a significantly higher concentration of NH_4^+-N compared to Substrates. BSFL increased the NH_4^+-N concentration in the Residues compared to the Substrates. Treatments containing Biosolids1 generally had higher concentrations of NH_4^+-N compared to Food and Wheat Bran treatments

3.4 Total extractable elements

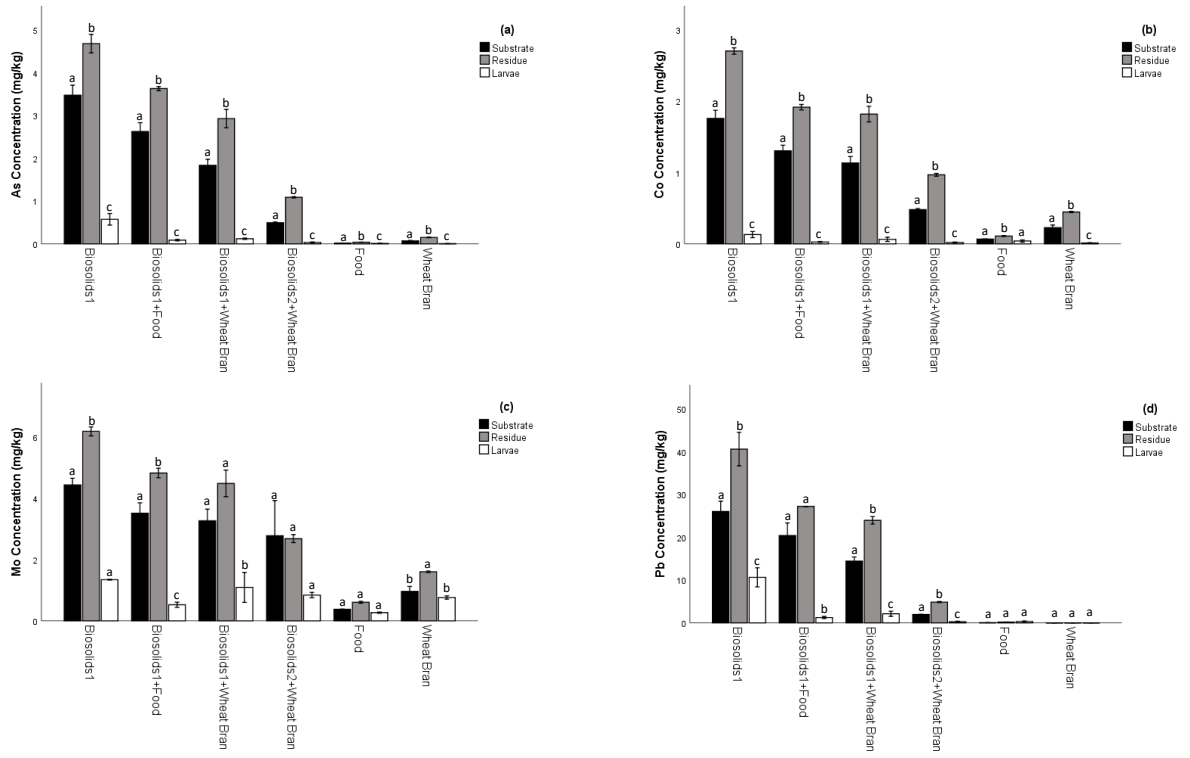

Figure 13. Mean As (a), Co (b), Mo (c), and Pb (d) concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 13 shows in all treatments, As concentrations in BSFL were significantly lower than their respective Substrate, Which were significantly higher than the Residues. This indicates BSFL have excluded As from their bodies and most has remained in the Substrate.

Co also shows this significant observation, except for the Food treatment, where Substrates and BSFL had similar concentrations to each other. Co concentrations in Residue were significantly higher than both Substrate and BSFL, indicating the BSFL have accumulated a portion of Co, but also excluded a large portion of it, where the metal has concentrated.

Mo partitioning varied among treatments. Biosolids, Biosolids1+Food, and Food treatments had significantly lower concentrations of Mo in BSFL compared to Substrates, which was also significantly lower than the Residues. These observations indicated BSFL have excluded Mo from their bodies and concentrated into Residues. BSFL in the biosolids1+Wheat Bran treatment type was significantly lower than both Substrate and Residue, which showed to have no significant differences to one another. This indicates BSFL were able to exclude Mo from their body, but this did not show evidence of Residue concentration.

Pb had differing results among treatments. BSFL in Biosolids1 and biosolids blended with Wheat Bran treatments had significantly lower Pb concentrations than the Substrates. These Substrates were also significantly lower than Residues, indicating BSFL have excluded Pb and it has concentrated in the Residues. BSFL in the Biosolids1+Food treatment were significantly lower than their respective Substrates and Residues, which did not show significant differences. Food Substrate, Residue, and BSFL were not significantly different to each other, while Wheat Bran samples were all below detection limits (<0.01)

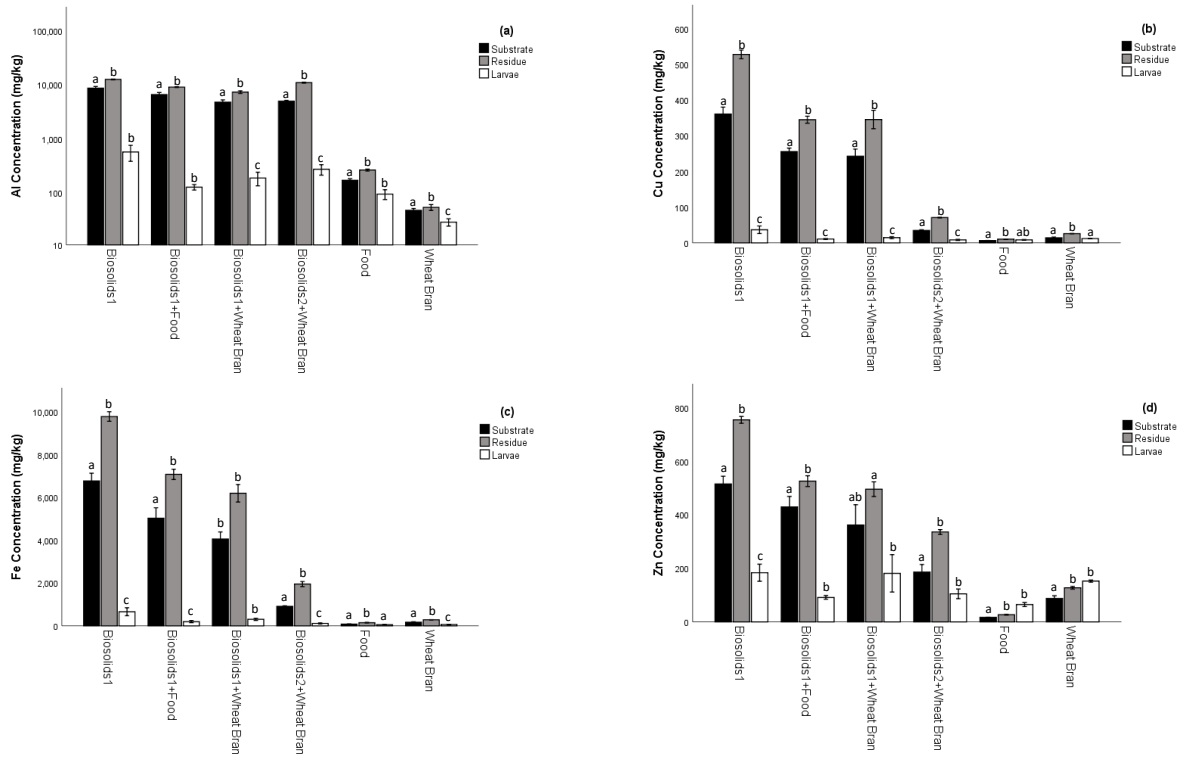

Figure 14. Mean Al (a), Cu (b), Fe (c), and Zn (d) concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 14 shows that in all treatments containing biosolids, BSFL had significantly lower concentrations of Al, Fe, and Cu compared to Substrates, which were significantly lower than Residues. These results show BSFL have excluded Al, Fe, and Cu from their bodies and instead have accumulated them in Residues.

Food treatment had variable results across Al, Fe, Cu, and Zn. BSFL in the Food treatment type was significantly higher than in the Residue, which was also significantly higher than the Substrate. This indicates BSFL have not excluded Al from their body and have accumulated it, resulting in a lower concentration in Residue. Fe concentrations in BSFL and Substrate of the Food treatment type are not significantly different to each other. Despite this, Residues are significantly higher than BSFL and Residues, showing BSFL have excluded a significant amount of Fe from their body. BSFL had significantly more Zn compared to the Substrates and Residue, which were not significantly different from each other. This indicates Zn accumulated in the BSFL, reducing concentrations in Residue.

BSFL in the Wheat Bran Treatment had significantly lower Al concentrations than its Substrate and Residue, which are similar to each other. This indicates BSFL have managed to exclude Al from their bodies, but not concentrate it in the Residue. BSFL had significantly lower Fe than in the Substrate. Substrate also had significantly lower concentrations of Fe compared to Residue, indicating BSFL excluded Fe and concentrated it into the Residue. BSFL and Substrate had similar concentrations of Cu, while Residue had significantly higher concentrations compared to both. Despite being similar to the Wheat Bran Substrate, BSFL have excluded a portion of Fe from its body. Substrate was observed to have significantly lower Zn concentrations, compared to Residue and BSFL, which showed similar concentrations. This indicates the BSFL did not exclude Zn from its body.

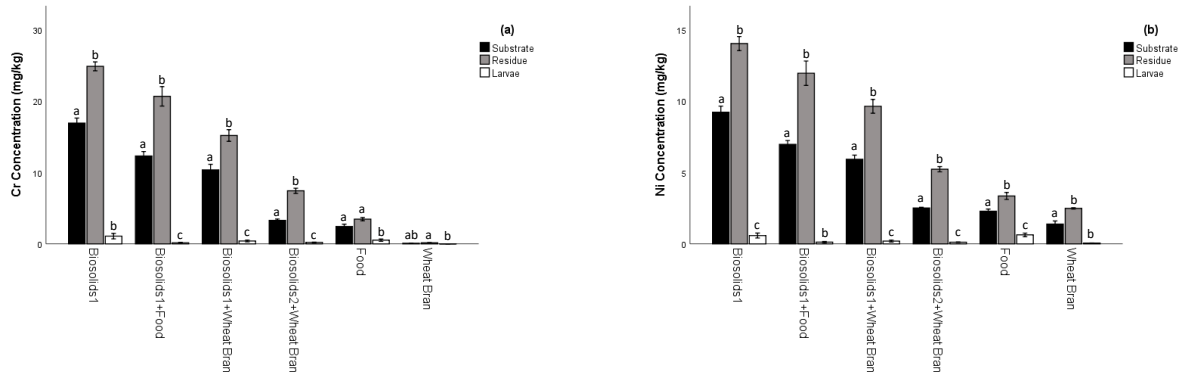

Figure 15. Mean Cr (a) and Ni (b) concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 15 shows that in treatments containing biosolids, BSFL had significantly lower concentrations of Cr compared to Substrates, which were significantly lower than Residues. BSFL have excluded Cr from their bodies, causing Cr to concentrate in Residues.

While BSFL feeding on food had significantly lower concentrations of Cr, Substrate and Residue were not significantly different. BSFL and Substrate in the Wheat Bran treatment type were not significantly different from one another. This was also the case with Substrate and Residue. BSFL had significantly lower concentrations of Cr to Residues. This result may be due to such a low initial Cr concentration in Wheat Bran.

Across all treatments, Ni concentrations in BSFL were significantly lower than Substrates, which were also significantly lower than the Residues. This result indicates BSFL have excluded Ni and it has been partitioned into the Residues.

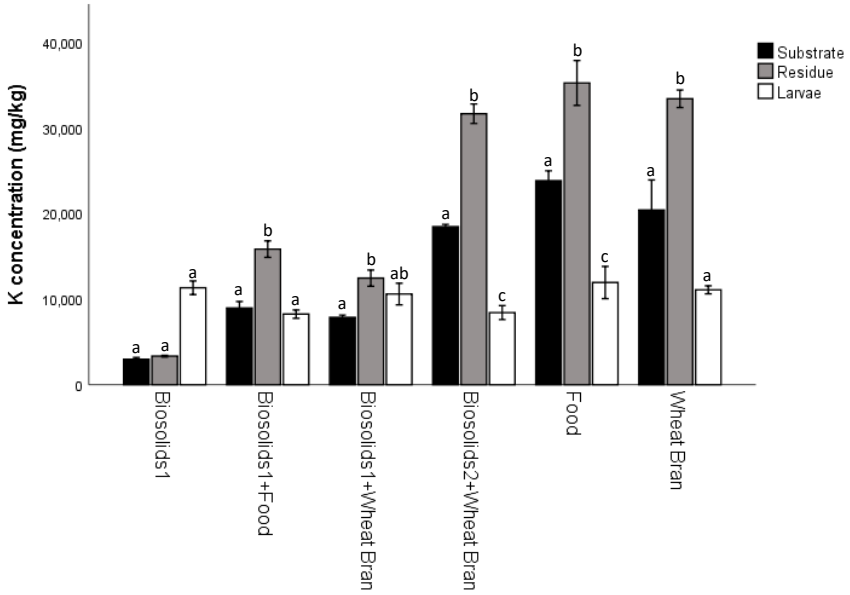

Figure 16. Mean K concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 16 shows that in the Biosolids1 treatment type, BSFL contained significantly higher concentrations of K compared to Substrate and Residue, while Substrate and Residue concentrations were not significantly different to one another. This result indicates BSFL have accumulated most of the K consumed, preventing a high K concentration in Residue. Residue in Biosolids1+Food and Wheat Bran treatment had significantly higher concentrations of K, compared to Substrates and BSFL, which did not have significant differences to each other.

This indicates BSFL have accumulated K but have excluded large portions which have partitioned into the Residues.

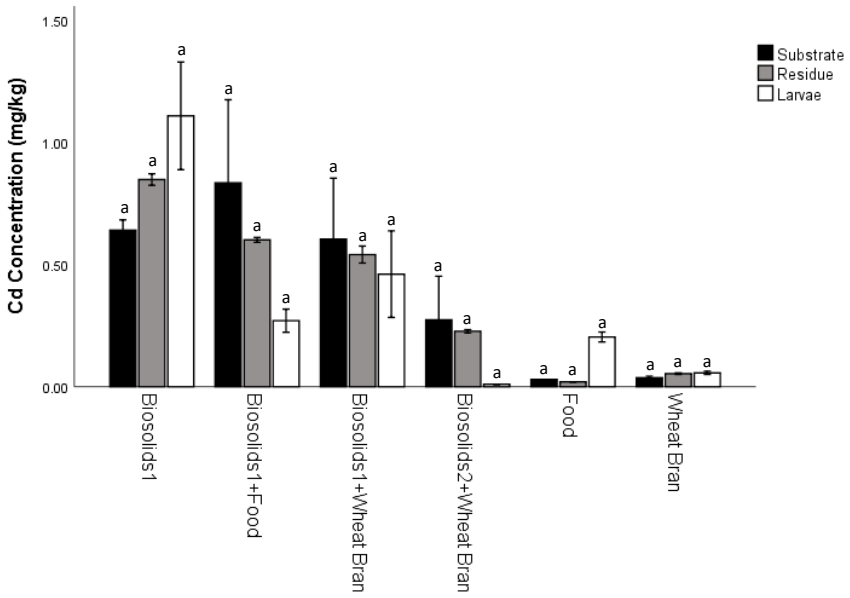

Figure 17. Mean Cd concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 17 shows that in the Food treatment type, BSFL had significantly higher concentrations of Cd, compared to Substrate and Residue. Substrate and Residue were not significantly different to one another. This indicates BSFL have accumulated most of the Cd in their bodies from the Substrate. All other treatments show Substrate, Residue, and BSFL were not significantly different from one another.

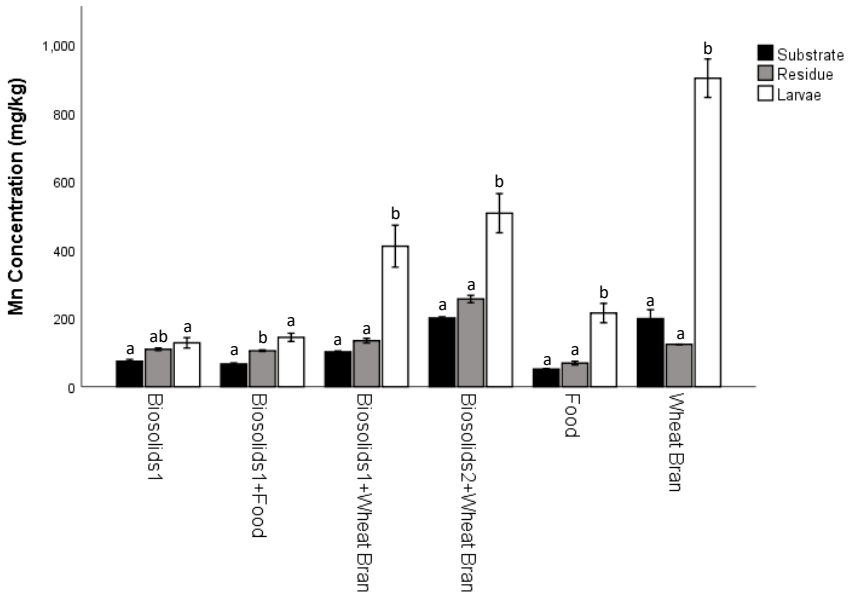

Figure 18. Mean Mn concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 18 shows that Bisolids1 Substrates and Residue were not significantly different to each other, While Residue was not significantly different to BSFL either. BSFL did contain significantly higher concentrations than the Substrate. This indicates that while the BSFL did exclude some concentration of Mn, a large portion of it was taken up by the BSFL.

In the Biosolids1+Food treatment, BSFL had significantly higher concentrations of Mn than the Residue, which was significantly higher than the Substrate. This result indicates BSFL accumulated the Mn, while partitioning some of this to the Residue.

In the Biosolids1+Wheat Bran, Biosolids2+Wheat Bran, Food, and Wheat Bran treatments, BSFL had significantly higher Mn concentrations, compared to both Substrate and Residue. The Substrate and Residue were not significantly different across these treatment types, indicating BSFL accumulated most of the Mn present.

3.5 $Ca(NO_3)_2$-extractable elements

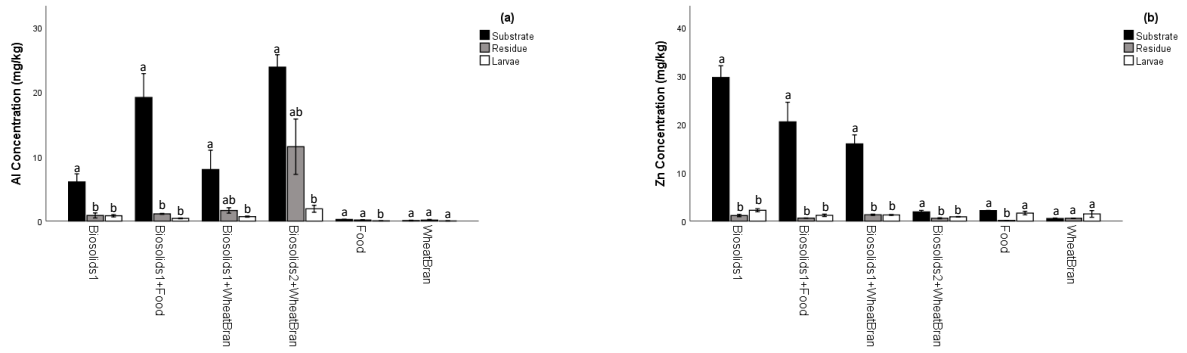

Figure 19. Mean concentrations (mg/kg d.w.) of Al (a) and Zn (b) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 19 shows that Substrates in the Biosolids1, Biosolids1+Food, and Biosolids2+Wheat Bran treatments contain significantly higher concentrations of Al and Zn than Residues and BSFL, which are not significantly different to each other. This indicates the BSFL have excluded both Al and Zn from their bodies but have not concentrated in the Residue.

BSFL in the Food treatment type contains significantly lower concentrations of Al than the Substrate and Residue, which are not significantly different to each other each other, indicating Al is excluded from the BSFL body. Zn concentrations in the Residue were

significantly lower than the Substrate and BSFL, indicating BSFL accumulate Zn in their bodies, while excluding it from their Residue.

BSFL in the Biosolids1+Wheat Bran treatment contains Al concentrations that are not significantly different to Residues and Substrates, indicating BSFL have not excluded it from their body. Zn concentrations are significantly higher in Substrate compared to Residue and BSFL, showing BSFL do not up Zn from the Substrate.

Substrates, Residues, and BSFL in the wheat Bran treatment type for do not significantly different concentrations of Al and Zn from one another, indicating BSFL are not excluding them from their bodies.

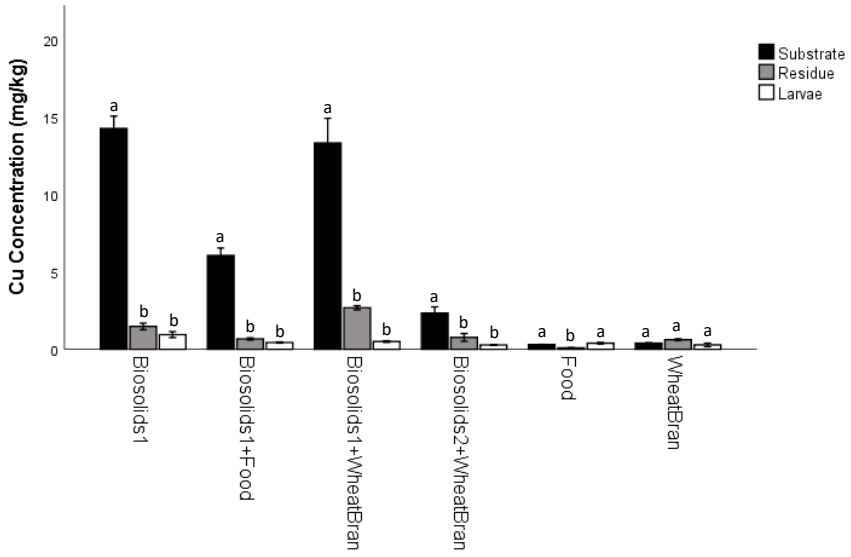

Figure 20. Mean concentrations (mg/kg d.w.) of Cu in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 20 show that in treatments containing biosolids, Substrates were significantly higher than in Cu concentration than both Residue and BSFL, which were not significantly different to one another. This indicates that the BSFL did not accumulate Cu or did not concentrate significant Cu in the Residue.

Cu concentration in the Residue of the Food treatment type is significantly lower than both the Substrate and BSFL, which are not significantly different to one another. This result provides evidence that BSFL accumulate Cu in the body and prevent concentration in the Residue.

Substrate, Residue, and BSFL in the Wheat Bran treatment are not significantly different to one another, therefore indicating no partitioning of Cu.

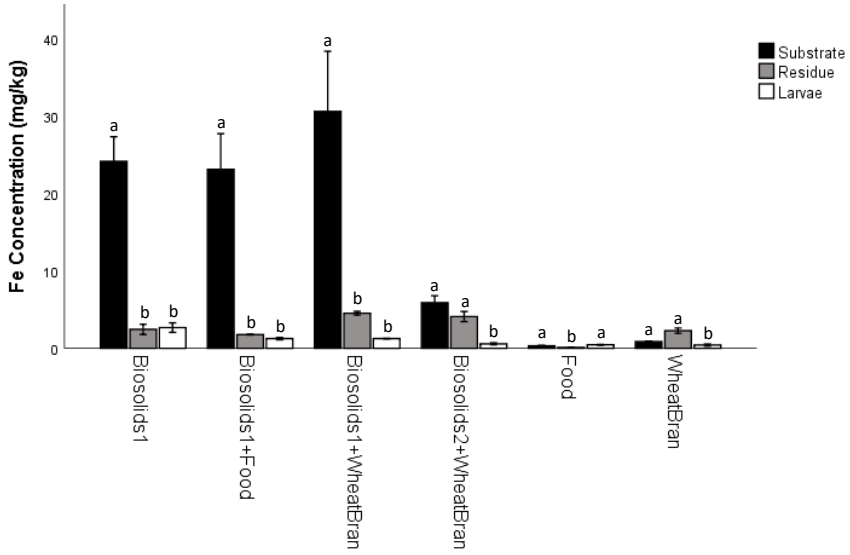

Figure 21. Mean Fe concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 21 shows that in the treatments containing Biosolids1, Substrates are significantly higher than Residues and BSFL, which are not significantly different to one another. Fe is not taken up by the BSFL or accumulated within the Residue.

Wheat Bran and Biosolids2+Wheat Bran treatment show BSFL contain significantly lower concentrations of Fe compared to both Substrates and Residues. Substrates and Residues do not have significant concentrations of Fe and are similar to one another. This indicates BSFL exclude some of the Fe, which shows partial accumulation in the Residue.

Fe concentration in the Residue of the Food treatment type is significantly lower than both the Substrate and BSFL, which are not significantly different to one another. This result provides evidence that BSFL accumulate Fe in the body and prevent concentration in the Residue.

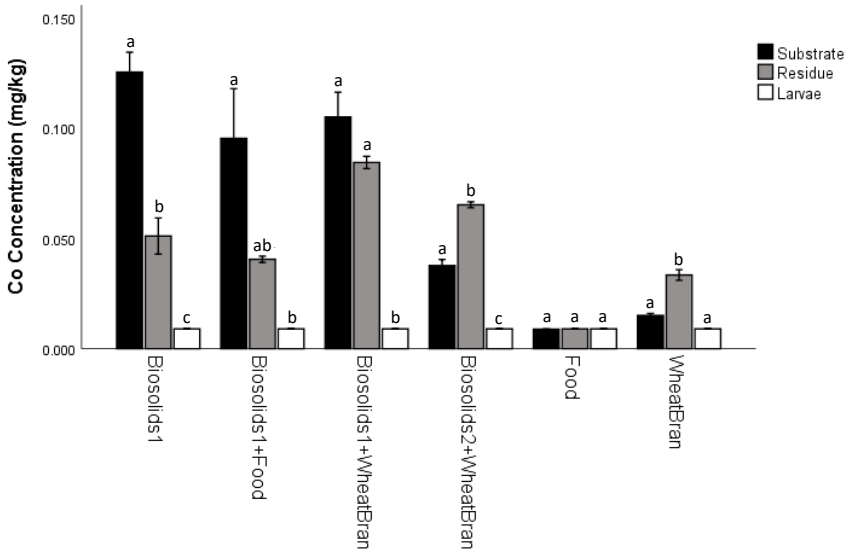

Figure 22. Mean Co concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 22 shows that in Biosolids1, BSFL had significantly lower concentrations of Co, compared to the Residue, which had significantly lower concentrations then the Substrate. These results indicate BSFL excluded Co from their bodies and it was partitioned into the Residue. Biosolids2+Wheat Bran BSFL had significantly lower concentrations of Co than in the Substrate, which were significantly lower than the Residues. This indicates the BSFL excluded Co from its body and concentrated it in the Residue.

In Biosolids1+Wheat Bran, BSFL had significantly lower concentrations in comparison to Substrate and Residue, which were not significantly different to one another. This shows Co consumed by the BSFL was excreted and partially concentrated in the Residues.

Co concentration in the Residue of the Wheat Bran treatment type is significantly higher than both the Substrate and BSFL, which are not significantly different to one another. This result provides evidence that BSFL accumulate Co in the body and prevent concentration in the Residue.

Co concentrations in Residue of the Biosolids1+Food treatment type were similar to both Substrate and BSFL. Co concentrations in Substrate and Residue were similar, while Residue and BSFL were also similar to one another. BSFL excluded a portion of Cr, while partially concentrating it into the Residue.

Substrates, Residues, and BSFL in the Food treatment had Co concentrations below detection limits.

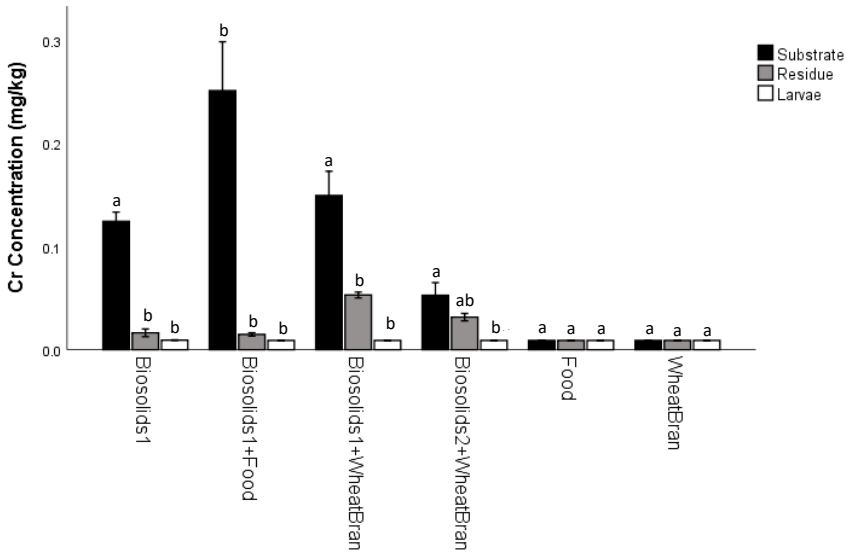

Figure 23. Mean Cr concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 23 shows that in treatment types containing Biosolids1, Substrates had a significantly higher concentration of Cr than both Residue and BSFL, which were not significantly different to one another. This indicates that the BSFL did not accumulate Cr or did not concentrate significant Cr in the Residue.

Cr concentrations in Residue of the Biosolids2+Wheat Bran treatment type were similar to both Substrate and BSFL. Cr concentrations in Substrate and Residue were similar, while Residue and BSFL were also similar to one another. BSFL excluded Cr, while partially concentrating it into the Residue

Substrate, Residue, and BSFL in Food and Wheat Bran treatments were below detection limits (<0.01) and therefore were not significantly different from one another.

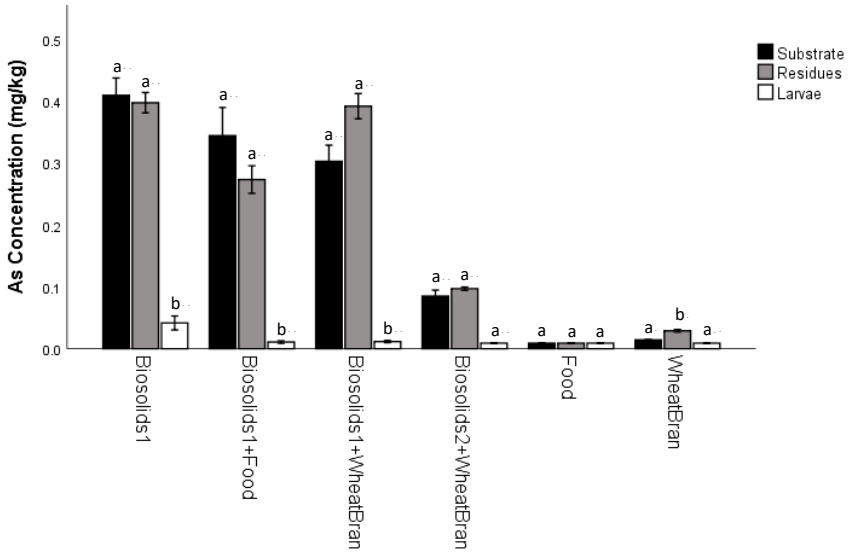

Figure 24. Mean As concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 24 shows that the BSFL in the Biosolids1+Wheat Bran treatment had significantly lower concentrations of As compared to the Substrate, which was significantly lower than the Residue. This provides evidence of that the BSFL excluded As from their body, concentrating it in the BSFL

The BSFL in Biosolids1, Biosolids1+Food, and Biosolids2+Wheat Bran treatments had significantly lower concentrations of As compared to the Substrate and Residue, which were not significantly different from one another. This indicates BSFL excluded As from their bodies and a large portion of this was concentrated in the Residue.

Residue in the Wheat Bran treatment type had significantly higher concentrations of As compared to the Substrate and BSFL, which were not significantly different to each other. Substrate and BSFL were also below detection limits. This may provide evidence of BSFL excluding As from its body despite having similar concentrations with the Substrate.

Substrate, Residue, and BSFL of the Food treatment type was below detection limits and therefore not significantly different from one another.

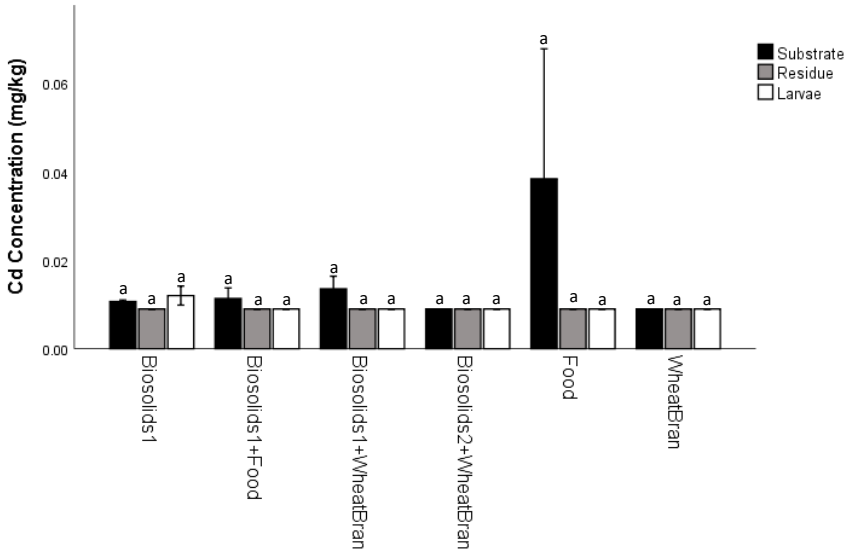

Figure 25. Mean Cd concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 25 Shows no treatment was observed to have any significant differences in their concentration of Cd among Substrates, Residues, or BSFL. All Residues and BSFL were below detection limits, except for Biosolids1 BSFL.

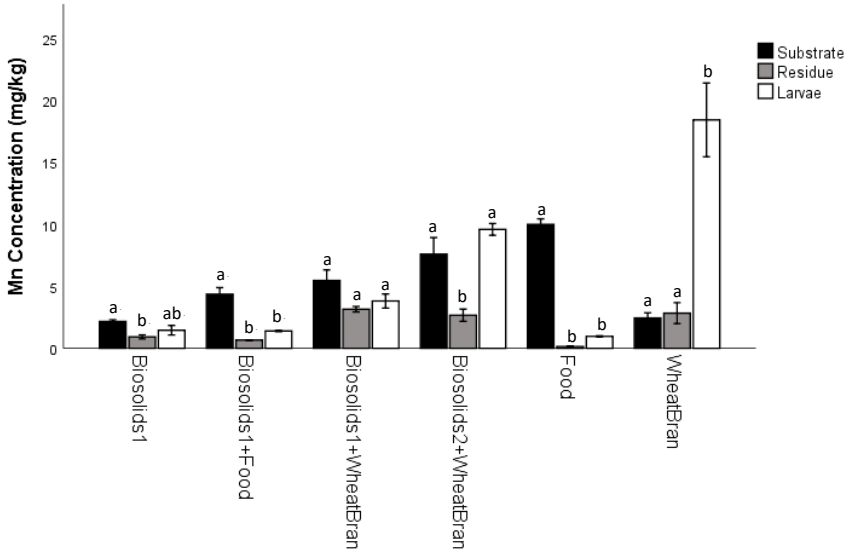

Figure 26. Mean Mn concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 26 shows highly variable partitioning across all treatment types. The concentration of Mn BSFL in the Biosolids1 treatment type is not significantly different to the concentration within the Substrate or Residue, while the Substrate has a significantly higher concentration to the Residue. This indicates most of the Mn in the Substrate has accumulated within the body of the BSFL.

The Biosolids1+Food and Food treatment types had significantly higher concentrations of Mn within the Substrate, while the BSFL and Residue were not significantly different. This shows partial partitioning of Mn between the BSFL and Residue is taking place.

The concentration of Mn in the Residue of the Biosolids2+Wheat Bran treatment type was significantly lower than the Substrate and BSFL, which were not significantly different. This indicates Mn is accumulating within the body of the BSFL, rather than being excreted by it.

There were no significant differences in Mn concentration in the Biosolids1+Wheat Bran sample types.

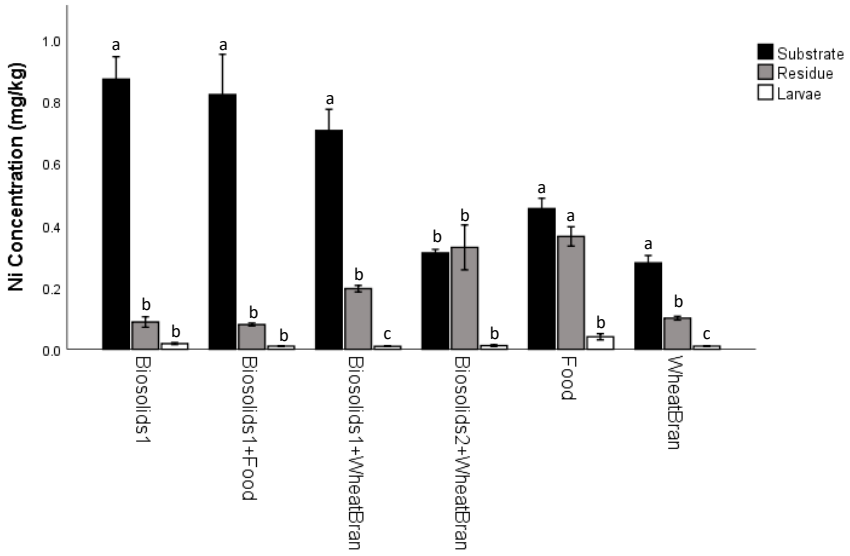

Figure 27. Mean Ni concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 27 Shows that in Wheat Bran and Biosolids1+Wheat Bran treatments, the BSFL had significantly lower Ni concentration than the Residues, which was significantly lower than the Substrates. This shows the BSFL has not accumulated soluble Ni or excreted it.

Biosolids2+Wheat Bran and Food treatments caused BSFL to have significantly lower concentrations of Ni compared to the Substrates and Residues, which are not significantly different from one another. This indicates the BSFL has stop Ni from accumulating in the body.

Biosolids1 and Biosolids1+Food treatments show that Substrates contain significantly higher concentrations of Ni than Residues and BSFL, which are similar to one another.

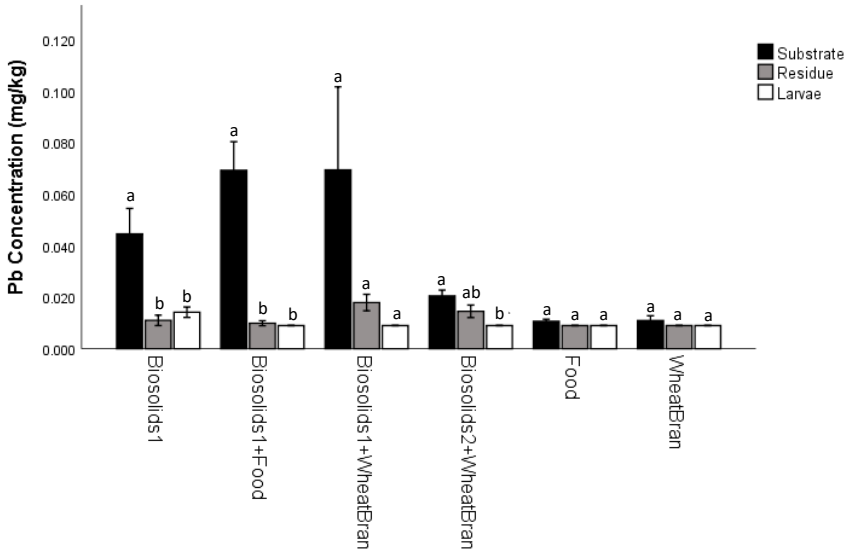

Figure 28. Mean Pb concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Figure 28 Shows Bisolids1 and Biosolids1+Food Substrate contains significantly higher concentrations of Pb compared to Residues and BSFL, which are not significantly different to one another. This indicate there is little accumulation of $Ca(NO_3)_2$-extractable Pb in the BSFL and Residue. This is especially true for Biosolids1+Food and Biosolids1+Wheat Bran BSFL, which are below detection limits.

shows that Bisolids2+Wheat Bran Substrates and Residue were not significantly different to each other, While Residue was not significantly different to BSFL either. BSFL did contain significantly lower concentrations than the Substrate. This indicates BSFL excluded some portion of Pb from their body, though not to a significant concentration, as shown by the Pb concentration in the Residue.

Pb concentrations among Substrates, Residues, and BSFL were not significantly different in Biosolids1+Wheat Bran, Food, and Wheat Bran treatment. Except for Biosolids1, all BSFL Pb concentrations were below detection limits (<0.01).

3.6 Bioaccumulation Coefficient & Mass Balance

Table 1. BSFL BAC for each treatment type across all total-extractable elements. Values >1 indicate bioaccumulation is occurring, while value <1 indicate no bioaccumulation is occurring.

BSFL	Na	Mg	Al	S	K	Ca	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Cd	Pb
Wheat bran	2.2	0.7	0.7	1.3	0.6	9.0	0.0	6.1	0.5	0.0	0.0	1.0	1.9	0.0	1.0	1.6	1.8
Wheat bran	2.7	0.7	0.6	1.5	0.7	8.0	0.0	4.7	0.4	0.1	0.0	1.0	2.1	0.0	0.8	1.6	0.8
Wheat bran	1.7	0.5	0.4	1.2	0.4	4.9	0.0	3.3	0.3	0.1	0.0	0.6	1.4	0.0	0.6	1.4	0.4
Food	0.5	2.4	0.4	1.5	0.7	2.4	0.4	5.3	0.8	0.8	0.4	1.5	4.9	0.3	0.8	7.7	6.5
Food	0.2	1.5	0.4	0.7	0.3	1.9	0.1	4.2	0.4	0.2	0.2	0.9	2.9	0.0	0.6	6.0	0.1
Food	0.4	1.6	0.8	1.2	0.5	1.6	0.3	3.1	0.8	0.8	0.3	1.6	3.8	0.7	0.8	6.7	10.5
Biosolids 1	0.2	0.7	0.0	0.2	2.9	4.4	0.0	1.3	0.0	0.0	0.0	0.0	0.2	0.1	0.3	0.9	0.2
Biosolids 1	0.3	0.9	0.1	0.4	4.1	5.8	0.1	2.0	0.1	0.1	0.1	0.1	0.4	0.2	0.3	2.2	0.5
Bosolids 1	0.3	1.0	0.1	0.5	4.6	5.7	0.1	1.9	0.2	0.1	0.1	0.2	0.5	0.3	0.3	2.2	0.6
Biosolids1+Food	0.3	1.2	0.0	0.4	1.2	4.9	0.0	2.7	0.1	0.0	0.0	0.1	0.3	0.0	0.2	0.6	0.1
Biosolids1+Food	0.2	0.9	0.0	0.3	0.9	3.4	0.0	2.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.7	0.1
Biosolids1+Food	0.2	0.9	0.0	0.3	0.7	2.2	0.0	1.9	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.1	0.0
Biosolids2+Wheat bran	1.0	0.5	0.1	0.8	0.4	7.1	0.1	2.2	0.1	0.0	0.1	0.2	0.4	0.1	0.5	0.0	0.1
Biosolids2+Wheat bran	0.7	0.4	0.0	0.7	0.4	7.8	0.0	2.3	0.1	0.0	0.0	0.2	0.5	0.0	0.1	0.1	0.0
Biosolids2+Wheat bran	1.5	0.6	0.1	1.0	0.6	9.3	0.1	3.0	0.2	0.1	0.1	0.3	0.9	0.1	0.7	0.1	0.2
Biosolids1+Wheat bran	0.2	0.6	0.0	0.3	1.0	4.7	0.1	2.7	0.1	0.0	0.0	0.0	0.2	0.1	0.1	0.2	0.1
Biosolids1+Wheat bran	0.4	0.9	0.0	0.6	1.5	7.9	0.0	4.5	0.1	0.0	0.0	0.1	0.5	0.1	0.3	1.0	0.1
Biosolids1+Wheat bran	0.4	1.0	0.1	0.5	1.6	9.0	0.0	4.9	0.1	0.1	0.0	0.1	1.1	0.1	0.7	2.1	0.2

Table 2 shows a large portion of non-essential elements were observed to have a BAC of <1, indicating no bioaccumulation. The essential elements of Ca and Mn had extremely high bioaccumulation values across all treatment types, most pronounced in BSFL fed on Substrates containing Wheat Bran. Interestingly, Wheat Bran and Food showed evidence of bioaccumulation (>1) for Cu, Zn, Cd, and Pb. This could be a result of minute concentrations across Substrate, Residue, and BSFL.

4 Discussion

4.1 BSFL Performance

Understanding how the performance of BSFL varies based on treatment types is crucial when considering which treatment is most beneficial to scale up. It is important for BSFL to have adequate growth and survival rates if they are to be used as a food or agricultural product at a commercial scale. Based on results, BSFL recovery was similar across all treatments types and no significant differences were found. The survivability of BSFL has had mixed results in the literature. Cai, Hu, et al. (2018) observed a reduction in larval survivability when Substrates had high concentrations of Zn, Cu, and Cd, which several treatment Substrates did. Gold et al. (2020) unexpectedly observed faecal sludge to have the highest survivability rate among canteen waste, cow manure, poultry slaughterhouse waste, and mill by-products. Results were more comparable to Lalander et al. (2019), which saw no significant differences in BSFL survival rates despite feeding BSFL human faeces (treated and untreated), which are expected to be a toxic Substrate to feed BSFL based on their comparatively high concentration of HMs relative to other Substrate treatment types.

BSFL weight gain did, however, have significant differences. Results show BSFL did not grow well on strictly Food or Biosolids1 Substrates, but when mixed with others, significantly increased BSFL growth rates. This aligns with several other studies containing a range of blended substrate types (Cai, Hu, et al., 2018; Lalander et al., 2019; Lalander et al., 2019; Tschirner & Simon, 2015).

Protein calculated using Janssen et al. (2017) nitrogen-to-protein conversion showed Substrates containing biosolids generally had a high protein content, which resulted in increased protein content of the BSFL. Interestingly Wheat Bran Substrates had a comparatively low protein content, but a high protein content seen in BSFL, comparable to blended treatment types. When feeding on a low-protein diet, gut microbes encourage fly larvae development by producing metabolites from carbohydrates, which causes increased amino acid extraction, thereby increasing larvae development (Rhinesmith-Carranza, Liu, Tomberlin, Longnecker, & Tarone, 2018). Millings and brewers waste, which has include wheat bran in the literature has been identified as having a similar amino acid profile as the

BSFL (Gold et al., 2018), which could explain why nitrogen and protein content was so high despite such a low N content in the substrate.

BSFL fed animal manure have reported crude protein content ranging from 350-570 g/kg and have shown to improve growth rates of chickens, pigs, and fish due to the high protein and fat content. Given treatments containing biosolids caused a higher weight and protein increase compared to Biosolids1 and Food alone and was similar to Wheat Bran, BSFL fed biosolids mixed with other organic matter may result in higher crude protein and therefore improved growth of the animals mentioned above (De Marco et al., 2015; Veldkamp et al., 2012).

Food wastes (which includes vegetables and fruits) typically have a low content of proteins and differ in essential amino acids to the BSFL. Previous studies report that a high content of some types of fibre may also hinder the development of BSFL. Barragán-Fonseca (2018) showed large amounts of fibre can reduce how well BSFL process Substrates due to the reduction of nutrient density, requiring longer development times. Substrates differ in composition and microbes, which are occasionally unable to breakdown macronutrients such as some types of fibre. This may be why BSFL fed on food waste in this study had lower growth rates compared to other treatment types. The blending or co-treatment of Substrates may allow the breakdown of indigestible macronutrients through increasing microbial diversity and nutrients. A comparison of weight gain in treatment types Biosolids1+Food and Food is evidence of this co-treatment. Pure Biosolids1 can also be compared with Biosolid1 blended treatments to reach the same conclusion.

Fat was not calculated in this study. It would likely impact the development of the BSFL as fat accumulation is important for the adult phase of the fly to store energy, when it is no longer capable of eating. Although this had no obvious impact on the BSFL recovery, this may have played a role in BSFL weight gain (Lalander et al., 2019).

Other studies reported sources of variability in the performance in BSFL may be differences in moisture content, pH, genetics of the BSF, feeding intervals, temperature, humidity, and harvesting times. Because there is no standardized procedure for BSFL rearing, variability among survivability and performance in different studies is inevitable (Gold et al., 2018; Leslie Holmes, 2010; LA Holmes, VanLaerhoven, & Tomberlin, 2016; Ma et al., 2018).

BSF facilities currently in commission has shown to be in a sustainable state when the Substrates used to feed BSFL are consistently available and BSFL process performance is high (Protix, 2018). To make this process feasible large, consistent volumes of BSFL would need to be produced (Gold et al., 2018). While it is clear the treatment types used in this project did not find significant differences in BSFL recovery rates, growth rates were different and would be a major factor in considering which treatment would be commercially viable. Some food wastes have been calculated to be economically feasible, with a big advantage being the ability to neglect sterility. With this in mind, the BSFL ability to grow so well using biosolids may prove to have higher economic feasibility if shown to be sanitary (Coudron et al., 2019; Pleissner & Smetana, 2020).

4.2 Carbon and Nitrogen

C content in biowaste is largely in the form of carbohydrates, which once eaten are generally converted into lipids and fats in the BSFL if the diet is balanced. BSFL consistently contained high C content as they are required to store large amounts of fats and lipids to survive adulthood, which is likely why C content was so high in BSFL (>40%). BSFL also use carbohydrates to produce simple sugars, which is used in larval metabolism (Pimentel, Montali, Bruno, & Tettamanti, 2017; Spranghers et al., 2017). N content in the BSFL is associated with protein content and the assimilation of nitrogenous wastes, which is toxic in excess, and therefore species of fly such as the fruit fly have shown moderate their intake (Almeida de Carvalho & Mirth, 2017). Mechanisms studied in other species of fly are relied on to provide some explanation of results, as the mechanisms controlling macronutrient content of the BSFL are not well understood.

Consideration of C/N ratios are important if any end-products are used as soil conditioners or fertilizers. A C/N ratio of 24:1 is the optimal ratio for microorganisms to continue nutrient cycling properly. Excess C will result in reduced nutrient cycling and microorganisms will have to wait for an input of N. Conversely, if N is in excess, it may result in runoff or leaching which could damage the surrounding environment (Moore, Klose, & Tabatabai, 2000). Wheat Bran Residue is closest to the ideal ratio and could potentially be used for agricultural purposes. Although most of the other Substrates and Residues C/N ratios are too low and Food substrate is too high to be used for soil treatment in its current state, manipulating the ratio

by either increasing C or N may allow these other substrates and residues to be used (Arbab & Mubarak, 2016). Green and Popa (2012) also observed the increase in C and N concentration in the BSFL and the assimilation of NH_4^+-N can reduce potential pollution, which could have otherwise been lost out of the system as Greenhouse gases. Using Residues as soil fertilisers will also return biosolids and food waste back into the soil where nutrients can be re-used.

4.3 NO_3^--N & NH_4^+-N

As expected, pure Biosolids1 had the highest concentration of NH_4^+-N, while Substrates blended with biosolids had elevated levels NH_4^+-N. Food contained the lowest observed concentration. NH_4^+-N was observed to have high concentrations in Residue compared to the Substrate. This pattern is similar to NH_4^+-N assimilation and partitioning previously observed in BSFL by Klammsteiner et al. (2020), where there was an increase in NH_4^+-N concentration in Residues and pH, which was observed to be between 7.5-8 at the end of the trial. This has been associated with the rise in NH_4^+-N and aligns with observations seen in this project. The results also align with Green and Popa (2012), who observed an increase of NH_4^+-N in composting leachate when compost was treated using BSFL. NH_4^+-N production in species of fly is driven by protein metabolism (Almeida de Carvalho & Mirth, 2017), which is why Substrates that had a high protein content, also contained high levels of NH_4^+-N (i.e Biosolids1).

NO_3^--N concentrations were similar across treatment types, except for the Food substrate. The large decrease in the NO_3^-N concentration in the Food treatment was consistent with Green and Popa (2012), who observed large decreases in NO_3^--N during and post treatment. A reduction in NO_3^--N concentration may be beneficial if the wastes were to be used as a soil amendment because high NO_3^--N concentration may result in excessive NO_3^--N leaching (Kirchmann, Johnston, & Bergström, 2002).

4.4 Total Extractable Elements

The BSFL has shown to desirably partition HMs into the Residue, while excluding them from the body. These findings align with some of previous studies. Research prior to this study has

observed BSFL accumulating HMs to undesirable concentrations (Cai, Hu, et al., 2018; Tschirner & Simon, 2015), while other research shows BSFL are capable of consuming contaminated Substrates and maintained low HM concentrations (Proc et al., 2020).

Non-essential elements typically accumulated within the BSFL at minute concentrations, while largely being partitioned into the Residues. The BSFL used within this study were successfully able to “pass” most non-essential elements and exhibited the potential to be create low-metal products from Substrates blended with biosolids. This is particularly important for HMs such as Cu, As, and Pb, which can be quite toxic to humans, plants, and animals.

Portions of essential elements such as Cu, Fe, K, and Zn, bioaccumulated within the BSFL body, while most of it was concentrated in the residue. These heavy metals are essential for metabolic processes in many fly larvae and therefore some accumulation is expected (Balamurugan et al., 2007). High concentrations of elements in Residues were also observed by Proc et al. (2020), who observed bioaccumulation of essential elements, particularly Mn, and stated the reduction of mass lead to the bioconcentration in Residues.

Cd was the only HM found to evenly partition through Substrate, Residue, and BSFL. This result. To use Substrates, Residue, and BSFL as end-products in a safe manner, monitoring strategies would need to be in place to prevent toxic concentrations of Cd accumulating in soils should the Reside be used as a soil conditioner or bioaccumulation in animals should the BSFL be used as a livestock food source (Tschirner & Simon, 2015).

The BACs for total-extractable elements showed BSFL largely did not bioaccumulate HMs (<1) blended treatment types. BSFL had higher bioaccumulation values for essential nutrients, particularly Ca and Mn. Residues contrasted this with generally much higher BAFs for non-essential elements and lower bioaccumulation values for essential elements as also seen by Diener et al. (2015). This result provides further evidence of desirable partitioning of elements, particularly among potentially toxic HMs. Interestingly, Food and Wheat Bran treatment type BSFL showed evidence for bioaccumulation of Cu, Cd, Zn, and Pb, though this may be unrepresentative as concentrations of HMs were quite low.

4.5 $Ca(NO_3)_2$- extractable elements

As far as the author is aware, no other research has attempted to measure the $Ca(NO_3)_2$-extractable elements. BSFL are able to effectively exclude the HMs analysed. This is beneficial as the solubility of toxic heavy metals are significantly reduced and therefore, they have been processed in a way which will prevent them from being bioavailable in the environment. Mn, Zn, Fe, and Cu were observed to have slightly elevated concentrations, but these essential elements are required by insects and flies to carry out normal metabolic function. Because of this it is reasonable to expect higher concentrations in their soluble form (Balamurugan et al., 2007).

5 Conclusion

BSFL may enable the beneficial reuse of a significant fraction of biosolids that would otherwise go to landfill. BSFL are able to transform biosolids into potentially high-value organic matter that contain low concentrations of Cu, Zn, and Pb, which prohibit the repeated applications of biosolids to soil. These elements are partitioned into a relatively small volume of Residues, which may go to landfill or be used to revegetate contaminated sites such as mine tailings. BSFL were able to survive at similar rates across all treatment types and grew well across many blended treatment types comparable to a “clean” Substrate such as Wheat Bran. BSFL have shown to bioaccumulate essential elements with Mn being a prime example of this. Soluble HMs found in Substrates show large decreases in bioavailability once treated by BSFL with Residues also having decreased soluble HMs. The BSFL also produce high concentrations of NH_4^+-N, which is found in Residues. The uptake of N across all treatment types provided a proxy of how protein content in BSFL increases, showing the BSFL’s ability to turn biowastes and biosolids, which may contain fairly low N, into an organism with a high protein content.

6 Future Research

Future research should aim to detail a comprehensive composition of the BSFL, investigating lipid, protein, and amino acid profile with each treatment type that is used. Mechanisms in the BSFL are not well understood and require investigation to understand how substrate composition changes BSFL macronutrient content. Although protein was approximated, it cannot be used to determine actual content. This will allow end products of the process to be applied to suitable markets. For BSFL to be used to treat biosolids mixed with other Substrates at the commercial scale, it will also be crucial to further investigate its ability to deal with pathogens.

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8 Appendix

Appendix A – Other Chemical Concentration Graphs

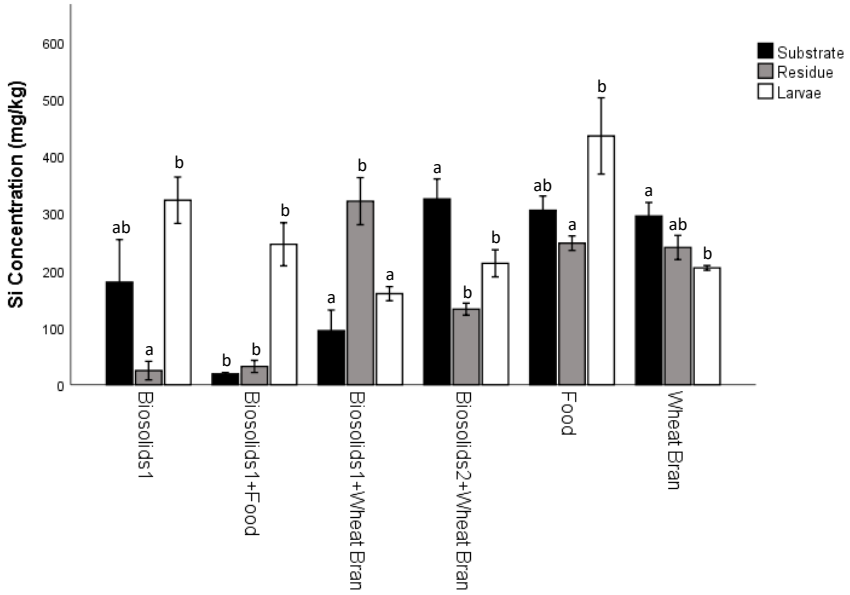

Figure 29. Mean Si concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

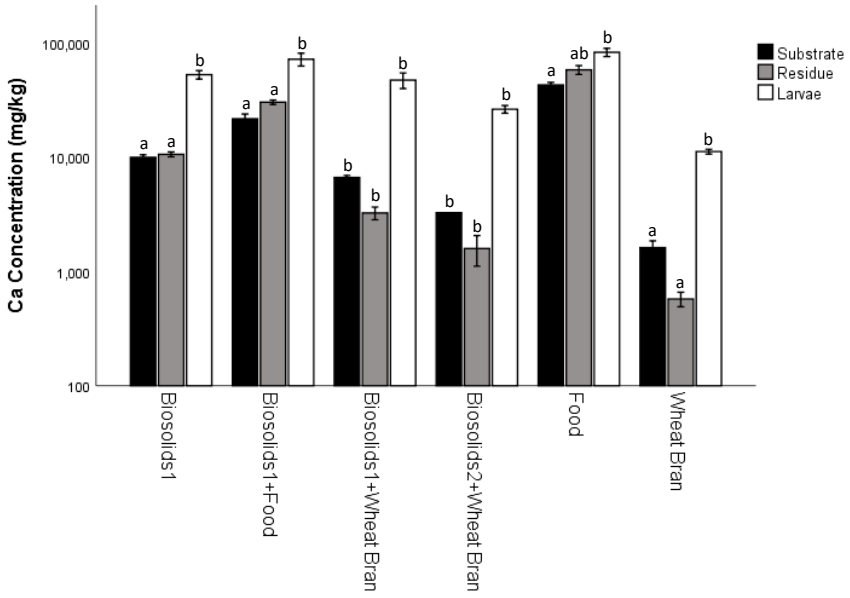

Figure 30. Mean Ca concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

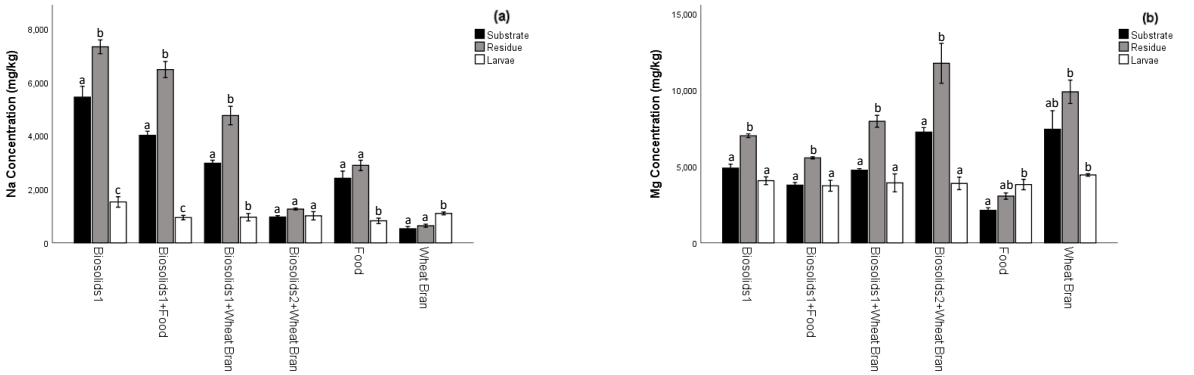

Figure 31. Mean Na (a) and Mg concentrations (mg/kg d.w.) in the Substrate, Residue, and BSFL for each treatment type (mean ± SE, n=3).

Appendix B – Total Extractable Elements Statistical Analyses

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Na

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	549409.248[a]	2	274704.624	21.013	.002
Intercept	5140271.414	1	5140271.414	393.189	.000
SampleType	549409.248	2	274704.624	21.013	.002
Error	78439.780	6	13073.297		
Total	5768120.442	9			
Corrected Total	627849.028	8			

a. R Squared = .875 (Adjusted R Squared = .833)

Multiple Comparisons

Dependent Variable: Wheat Bran - Na

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	458.0067*	93.35701	.006	171.5617	744.4516
	substrate	571.6067*	93.35701	.002	285.1617	858.0516
residues	larvae/pupae	-458.0067*	93.35701	.006	-744.4516	-171.5617
	substrate	113.6000	93.35701	.487	-172.8449	400.0449
substrate	larvae/pupae	-571.6067*	93.35701	.002	-858.0516	-285.1617
	residues	-113.6000	93.35701	.487	-400.0449	172.8449

Based on observed means.

The error term is Mean Square(Error) = 13073.297.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Mg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	44411847.364[a]	2	22205923.682	10.780	.010
Intercept	472302570.434	1	472302570.434	229.283	.000
SampleType	44411847.364	2	22205923.682	10.780	.010
Error	12359479.217	6	2059913.203		
Total	529073897.015	9			
Corrected Total	56771326.581	8			

a. R Squared = .782 (Adjusted R Squared = .710)

Multiple Comparisons

Dependent Variable: Wheat Bran - Mg

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-5432.3300*	1171.86837	.008	-9027.9440	-1836.7160
	substrate	-2986.8433	1171.86837	.096	-6582.4573	608.7706
residues	larvae/pupae	5432.3300*	1171.86837	.008	1836.7160	9027.9440
	substrate	2445.4867	1171.86837	.173	-1150.1273	6041.1006
substrate	larvae/pupae	2986.8433	1171.86837	.096	-608.7706	6582.4573
	residues	-2445.4867	1171.86837	.173	-6041.1006	1150.1273

Based on observed means.

The error term is Mean Square(Error) = 2059913.203.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1054.532[a]	2	527.266	6.587	.031
Intercept	16426.694	1	16426.694	205.203	.000
SampleType	1054.532	2	527.266	6.587	.031
Error	480.306	6	80.051		
Total	17961.533	9			
Corrected Total	1534.839	8			

a. R Squared = .687 (Adjusted R Squared = .583)

Multiple Comparisons

Dependent Variable: Wheat Bran - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-25.4767*	7.30530	.030	-47.8913	-3.0620
	substrate	-19.1000	7.30530	.088	-41.5147	3.3147
residues	larvae/pupae	25.4767*	7.30530	.030	3.0620	47.8913
	substrate	6.3767	7.30530	.675	-16.0380	28.7913
substrate	larvae/pupae	19.1000	7.30530	.088	-3.3147	41.5147
	residues	-6.3767	7.30530	.675	-28.7913	16.0380

Based on observed means.

The error term is Mean Square(Error) = 80.051.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Si

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12577.540[a]	2	6288.770	6.157	.035
Intercept	548443.925	1	548443.925	536.973	.000
SampleType	12577.540	2	6288.770	6.157	.035
Error	6128.171	6	1021.362		
Total	567149.636	9			
Corrected Total	18705.711	8			

a. R Squared = .672 (Adjusted R Squared = .563)

Multiple Comparisons

Dependent Variable: Wheat Bran - Si

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-35.8000	26.09421	.411	-115.8642	44.2642
	substrate	-90.8900*	26.09421	.030	-170.9542	-10.8258
residues	larvae/pupae	35.8000	26.09421	.411	-44.2642	115.8642
	substrate	-55.0900	26.09421	.168	-135.1542	24.9742
substrate	larvae/pupae	90.8900*	26.09421	.030	10.8258	170.9542
	residues	55.0900	26.09421	.168	-24.9742	135.1542

Based on observed means.

The error term is Mean Square(Error) = 1021.362.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - S

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2620387.872[a]	2	1310193.936	4.412	.066
Intercept	95798484.029	1	95798484.029	322.626	.000
SampleType	2620387.872	2	1310193.936	4.412	.066
Error	1781601.234	6	296933.539		
Total	100200473.135	9			
Corrected Total	4401989.106	8			

a. R Squared = .595 (Adjusted R Squared = .460)

Multiple Comparisons

Dependent Variable: Wheat Bran - S

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-461.3100	444.92212	.583	-1826.4532	903.8332
	substrate	842.0000	444.92212	.221	-523.1432	2207.1432
residues	larvae/pupae	461.3100	444.92212	.583	-903.8332	1826.4532
	substrate	1303.3100	444.92212	.059	-61.8332	2668.4532
substrate	larvae/pupae	-842.0000	444.92212	.221	-2207.1432	523.1432
	residues	-1303.3100	444.92212	.059	-2668.4532	61.8332

Based on observed means.

The error term is Mean Square(Error) = 296933.539.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - K

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	752846557.626[a]	2	376423278.813	27.642	.001
Intercept	4208624198.688	1	4208624198.688	309.058	.000
SampleType	752846557.626	2	376423278.813	27.642	.001
Error	81705457.944	6	13617576.324		
Total	5043176214.258	9			
Corrected Total	834552015.570	8			

a. R Squared = .902 (Adjusted R Squared = .869)

Multiple Comparisons

Dependent Variable: Wheat Bran - K

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-22302.0567*	3013.03571	.001	-31546.8776	-13057.2357
	substrate	-9310.6533*	3013.03571	.049	-18555.4743	-65.8324
residues	larvae/pupae	22302.0567*	3013.03571	.001	13057.2357	31546.8776
	substrate	12991.4033*	3013.03571	.012	3746.5824	22236.2243
substrate	larvae/pupae	9310.6533*	3013.03571	.049	65.8324	18555.4743
	residues	-12991.4033*	3013.03571	.012	-22236.2243	-3746.5824

Based on observed means.

The error term is Mean Square(Error) = 13617576.324.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Ca

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	208100895.488[a]	2	104050447.744	295.414	.000
Intercept	181457423.576	1	181457423.576	515.183	.000
SampleType	208100895.488	2	104050447.744	295.414	.000
Error	2113317.259	6	352219.543		
Total	391671636.323	9			
Corrected Total	210214212.747	8			

a. R Squared = .990 (Adjusted R Squared = .987)

Multiple Comparisons

Dependent Variable: Wheat Bran - Ca

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	10684.8833*	484.57510	.000	9198.0739	12171.6928
	substrate	9634.9233*	484.57510	.000	8148.1139	11121.7328
residues	larvae/pupae	-10684.8833*	484.57510	.000	-12171.6928	-9198.0739
	substrate	-1049.9600	484.57510	.156	-2536.7695	436.8495
substrate	larvae/pupae	-9634.9233*	484.57510	.000	-11121.7328	-8148.1139
	residues	1049.9600	484.57510	.156	-436.8495	2536.7695

Based on observed means.

The error term is Mean Square(Error) = 352219.543.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.030[a]	2	.015	8.502	.018
Intercept	.062	1	.062	35.095	.001
SampleType	.030	2	.015	8.502	.018
Error	.011	6	.002		
Total	.103	9			
Corrected Total	.041	8			

a. R Squared = .739 (Adjusted R Squared = .652)

Multiple Comparisons

Dependent Variable: Wheat Bran - Cr

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.1410*	.03432	.015	-.2463	-.0357
	substrate	-.0810	.03432	.122	-.1863	.0243
residues	larvae/pupae	.1410*	.03432	.015	.0357	.2463
	substrate	.0600	.03432	.264	-.0453	.1653
substrate	larvae/pupae	.0810	.03432	.122	-.0243	.1863
	residues	-.0600	.03432	.264	-.1653	.0453

Based on observed means.

The error term is Mean Square(Error) = .002.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1101217.862[a]	2	550608.931	143.588	.000
Intercept	1495623.009	1	1495623.009	390.030	.000
SampleType	1101217.862	2	550608.931	143.588	.000
Error	23007.800	6	3834.633		
Total	2619848.671	9			
Corrected Total	1124225.662	8			

a. R Squared = .980 (Adjusted R Squared = .973)

ultiple Comparisons

Dependent Variable: Wheat Bran - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	776.6567*	50.56107	.000	621.5214	931.7919
	substrate	701.7167*	50.56107	.000	546.5814	856.8519
residues	larvae/pupae	-776.6567*	50.56107	.000	-931.7919	-621.5214
	substrate	-74.9400	50.56107	.363	-230.0753	80.1953
substrate	larvae/pupae	-701.7167*	50.56107	.000	-856.8519	-546.5814
	residues	74.9400	50.56107	.363	-80.1953	230.0753

Based on observed means.

The error term is Mean Square(Error) = 3834.633.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	70961.272[a]	2	35480.636	63.767	.000
Intercept	270115.808	1	270115.808	485.465	.000
SampleType	70961.272	2	35480.636	63.767	.000
Error	3338.438	6	556.406		
Total	344415.517	9			
Corrected Total	74299.709	8			

a. R Squared = .955 (Adjusted R Squared = .940)

Multiple Comparisons

Dependent Variable: Wheat Bran - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-217.4433*	19.25974	.000	-276.5375	-158.3492
	substrate	-104.3133*	19.25974	.004	-163.4075	-45.2192
residues	larvae/pupae	217.4433*	19.25974	.000	158.3492	276.5375
	substrate	113.1300*	19.25974	.003	54.0358	172.2242
substrate	larvae/pupae	104.3133*	19.25974	.004	45.2192	163.4075
	residues	-113.1300*	19.25974	.003	-172.2242	-54.0358

Based on observed means.

The error term is Mean Square(Error) = 556.406.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.282[a]	2	.141	96.097	.000
Intercept	.471	1	.471	320.905	.000
SampleType	.282	2	.141	96.097	.000
Error	.009	6	.001		
Total	.762	9			
Corrected Total	.291	8			

a. R Squared = .970 (Adjusted R Squared = .960)

Multiple Comparisons

Dependent Variable: Wheat Bran - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.4337*	.03128	.000	-.5296	-.3377
	substrate	-.2137*	.03128	.001	-.3096	-.1177
residues	larvae/pupae	.4337*	.03128	.000	.3377	.5296
	substrate	.2200*	.03128	.001	.1240	.3160
substrate	larvae/pupae	.2137*	.03128	.001	.1177	.3096
	residues	-.2200*	.03128	.001	-.3160	-.1240

Based on observed means.

The error term is Mean Square(Error) = .001.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8.835[a]	2	4.418	88.906	.000
Intercept	15.445	1	15.445	310.832	.000
SampleType	8.835	2	4.418	88.906	.000
Error	.298	6	.050		
Total	24.578	9			
Corrected Total	9.133	8			

a. R Squared = .967 (Adjusted R Squared = .956)

Multiple Comparisons

Dependent Variable: Wheat Bran - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-2.4233*	.18201	.000	-2.9818	-1.8649
	substrate	-1.3267*	.18201	.001	-1.8851	-.7682
residues	larvae/pupae	2.4233*	.18201	.000	1.8649	2.9818
	substrate	1.0967*	.18201	.002	.5382	1.6551
substrate	larvae/pupae	1.3267*	.18201	.001	.7682	1.8851
	residues	-1.0967*	.18201	.002	-1.6551	-.5382

Based on observed means.

The error term is Mean Square(Error) = .050.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	321.579[a]	2	160.789	34.012	.001
Intercept	2730.062	1	2730.062	577.494	.000
SampleType	321.579	2	160.789	34.012	.001
Error	28.365	6	4.727		
Total	3080.006	9			
Corrected Total	349.943	8			

a. R Squared = .919 (Adjusted R Squared = .892)

Multiple Comparisons

Dependent Variable: Wheat Bran - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-13.6400*	1.77528	.001	-19.0870	-8.1930
	substrate	-2.2100	1.77528	.473	-7.6570	3.2370
residues	larvae/pupae	13.6400*	1.77528	.001	8.1930	19.0870
	substrate	11.4300*	1.77528	.002	5.9830	16.8770
substrate	larvae/pupae	2.2100	1.77528	.473	-3.2370	7.6570
	residues	-11.4300*	1.77528	.002	-16.8770	-5.9830

Based on observed means.

The error term is Mean Square(Error) = 4.727.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6457.139[a]	2	3228.570	21.762	.002
Intercept	134603.380	1	134603.380	907.295	.000
SampleType	6457.139	2	3228.570	21.762	.002
Error	890.141	6	148.357		
Total	141950.661	9			
Corrected Total	7347.280	8			

a. R Squared = .879 (Adjusted R Squared = .838)

Multiple Comparisons

Dependent Variable: Wheat Bran - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	25.1600	9.94508	.098	-5.3542	55.6742
	substrate	65.0567*	9.94508	.001	34.5424	95.5709
residues	larvae/pupae	-25.1600	9.94508	.098	-55.6742	5.3542
	substrate	39.8967*	9.94508	.017	9.3824	70.4109
substrate	larvae/pupae	-65.0567*	9.94508	.001	-95.5709	-34.5424
	residues	-39.8967*	9.94508	.017	-70.4109	-9.3824

Based on observed means.

The error term is Mean Square(Error) = 148.357.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.030[a]	2	.015	112.508	.000
Intercept	.052	1	.052	393.307	.000
SampleType	.030	2	.015	112.508	.000
Error	.001	6	.000		
Total	.083	9			
Corrected Total	.031	8			

a. R Squared = .974 (Adjusted R Squared = .965)

Multiple Comparisons

Dependent Variable: Wheat Bran - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.1410*	.00943	.000	-.1699	-.1121
	substrate	-.0610*	.00943	.002	-.0899	-.0321
residues	larvae/pupae	.1410*	.00943	.000	.1121	.1699
	substrate	.0800*	.00943	.000	.0511	.1089
substrate	larvae/pupae	.0610*	.00943	.002	.0321	.0899
	residues	-.0800*	.00943	.000	-.1089	-.0511

Based on observed means.

The error term is Mean Square(Error) = .000.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Mo

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.155[a]	2	.578	19.986	.002
Intercept	11.089	1	11.089	383.699	.000
SampleType	1.155	2	.578	19.986	.002
Error	.173	6	.029		
Total	12.418	9			
Corrected Total	1.329	8			

a. R Squared = .869 (Adjusted R Squared = .826)

Multiple Comparisons

Dependent Variable: Wheat Bran - Mo

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.8400*	.13880	.002	-1.2659	-.4141
	substrate	-.2000	.13880	.381	-.6259	.2259
residues	larvae/pupae	.8400*	.13880	.002	.4141	1.2659
	substrate	.6400*	.13880	.009	.2141	1.0659
substrate	larvae/pupae	.2000	.13880	.381	-.2259	.6259
	residues	-.6400*	.13880	.009	-1.0659	-.2141

Based on observed means.

The error term is Mean Square(Error) = .029.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.001[a]	2	.000	3.444	.101
Intercept	.022	1	.022	215.111	.000
SampleType	.001	2	.000	3.444	.101
Error	.001	6	.000		
Total	.023	9			
Corrected Total	.001	8			

a. R Squared = .534 (Adjusted R Squared = .379)

Multiple Comparisons

Dependent Variable: Wheat Bran - Cd

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	.0033	.00816	.914	-.0217	.0284
	substrate	.0200	.00816	.109	-.0051	.0451
residues	larvae/pupae	-.0033	.00816	.914	-.0284	.0217
	substrate	.0167	.00816	.183	-.0084	.0417
substrate	larvae/pupae	-.0200	.00816	.109	-.0451	.0051
	residues	-.0167	.00816	.183	-.0417	.0084

Based on observed means.

The error term is Mean Square(Error) = .000.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.000[a]	2	.000	.	.
Intercept	.001	1	.001	.	.
SampleType	.000	2	.000	.	.
Error	.000	6	.000		
Total	.001	9			
Corrected Total	.000	8			

a. R Squared = . (Adjusted R Squared = .)

Tests of Between-Subjects Effects

Dependent Variable: Food - Na

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7046741.746[a]	2	3523370.873	29.462	.001
Intercept	37578452.949	1	37578452.949	314.224	.000
SampleType	7046741.746	2	3523370.873	29.462	.001
Error	717548.833	6	119591.472		
Total	45342743.528	9			
Corrected Total	7764290.579	8			

a. R Squared = .908 (Adjusted R Squared = .877)

Multiple Comparisons

Dependent Variable: Food - Na

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-2070.7000*	282.36085	.001	-2937.0606	-1204.3394
	substrate	-1589.8967*	282.36085	.003	-2456.2573	-723.5360
residues	larvae/pupae	2070.7000*	282.36085	.001	1204.3394	2937.0606
	substrate	480.8033	282.36085	.279	-385.5573	1347.1640
substrate	larvae/pupae	1589.8967*	282.36085	.003	723.5360	2456.2573
	residues	-480.8033	282.36085	.279	-1347.1640	385.5573

Based on observed means.

The error term is Mean Square(Error) = 119591.472.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Mg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4253750.720[a]	2	2126875.360	11.490	.009
Intercept	80953866.571	1	80953866.571	437.341	.000
SampleType	4253750.720	2	2126875.360	11.490	.009
Error	1110629.255	6	185104.876		
Total	86318246.546	9			
Corrected Total	5364379.975	8			

a. R Squared = .793 (Adjusted R Squared = .724)

Multiple Comparisons

Dependent Variable: Food - Mg

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	755.6567	351.28799	.159	-322.1913	1833.5047
	substrate	1681.1367*	351.28799	.007	603.2887	2758.9847
residues	larvae/pupae	-755.6567	351.28799	.159	-1833.5047	322.1913
	substrate	925.4800	351.28799	.086	-152.3680	2003.3280
substrate	larvae/pupae	-1681.1367*	351.28799	.007	-2758.9847	-603.2887
	residues	-925.4800	351.28799	.086	-2003.3280	152.3680

Based on observed means.

The error term is Mean Square(Error) = 185104.876.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	43546.584[a]	2	21773.292	34.560	.001
Intercept	281122.644	1	281122.644	446.210	.000
SampleType	43546.584	2	21773.292	34.560	.001
Error	3780.139	6	630.023		
Total	328449.367	9			
Corrected Total	47326.723	8			

a. R Squared = .920 (Adjusted R Squared = .894)

Multiple Comparisons

Dependent Variable: Food - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-170.1233*	20.49428	.000	-233.0054	-107.2413
	substrate	-76.8867*	20.49428	.022	-139.7687	-14.0046
residues	larvae/pupae	170.1233*	20.49428	.000	107.2413	233.0054
	substrate	93.2367*	20.49428	.009	30.3546	156.1187
substrate	larvae/pupae	76.8867*	20.49428	.022	14.0046	139.7687
	residues	-93.2367*	20.49428	.009	-156.1187	-30.3546

Based on observed means.

The error term is Mean Square(Error) = 630.023.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Si

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	55573.637[a]	2	27786.819	5.278	.048
Intercept	978088.034	1	978088.034	185.787	.000
SampleType	55573.637	2	27786.819	5.278	.048
Error	31587.373	6	5264.562		
Total	1065249.044	9			
Corrected Total	87161.010	8			

a. R Squared = .638 (Adjusted R Squared = .517)

Multiple Comparisons

Dependent Variable: Food - Si

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	187.8100*	59.24279	.044	6.0369	369.5831
	substrate	130.4067	59.24279	.149	-51.3665	312.1798
residues	larvae/pupae	-187.8100*	59.24279	.044	-369.5831	-6.0369
	substrate	-57.4033	59.24279	.621	-239.1765	124.3698
substrate	larvae/pupae	-130.4067	59.24279	.149	-312.1798	51.3665
	residues	57.4033	59.24279	.621	-124.3698	239.1765

Based on observed means.

The error term is Mean Square(Error) = 5264.562.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - S

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	240913.714[a]	2	120456.857	.772	.503
Intercept	40553164.605	1	40553164.605	260.022	.000
SampleType	240913.714	2	120456.857	.772	.503
Error	935762.233	6	155960.372		
Total	41729840.553	9			
Corrected Total	1176675.947	8			

a. R Squared = .205 (Adjusted R Squared = -.060)

Multiple Comparisons

Dependent Variable: Food - S

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-165.6367	322.44935	.868	-1154.9998	823.7265
	substrate	233.2200	322.44935	.760	-756.1431	1222.5831
residues	larvae/pupae	165.6367	322.44935	.868	-823.7265	1154.9998
	substrate	398.8567	322.44935	.477	-590.5065	1388.2198
substrate	larvae/pupae	-233.2200	322.44935	.760	-1222.5831	756.1431
	residues	-398.8567	322.44935	.477	-1388.2198	590.5065

Based on observed means.

The error term is Mean Square(Error) = 155960.372.

Tests of Between-Subjects Effects

Dependent Variable: Food - K

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	814126220.070[a]	2	407063110.035	34.659	.001
Intercept	5039517155.730	1	5039517155.730	429.079	.000
SampleType	814126220.070	2	407063110.035	34.659	.001
Error	70469752.995	6	11744958.832		
Total	5924113128.794	9			
Corrected Total	884595973.064	8			

a. R Squared = .920 (Adjusted R Squared = .894)

Multiple Comparisons

Dependent Variable: Food - K

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-23295.4167*	2798.20881	.000	-31881.0897	-14709.7436
	substrate	-11883.8900*	2798.20881	.013	-20469.5630	-3298.2170
residues	larvae/pupae	23295.4167*	2798.20881	.000	14709.7436	31881.0897
	substrate	11411.5267*	2798.20881	.015	2825.8536	19997.1997
substrate	larvae/pupae	11883.8900*	2798.20881	.013	3298.2170	20469.5630
	residues	-11411.5267*	2798.20881	.015	-19997.1997	-2825.8536

Based on observed means.

The error term is Mean Square(Error) = 11744958.832.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Ca

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2462816590.875[a]	2	1231408295.437	15.708	.004
Intercept	34093596304.104	1	34093596304.104	434.895	.000
SampleType	2462816590.875	2	1231408295.437	15.708	.004
Error	470370407.732	6	78395067.955		
Total	37026783302.710	9			
Corrected Total	2933186998.606	8			

a. R Squared = .840 (Adjusted R Squared = .786)

Multiple Comparisons

Dependent Variable: Food - Ca

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	24768.5000*	7229.34151	.032	2586.8950	46950.1050
	substrate	40156.5267*	7229.34151	.003	17974.9217	62338.1317
residues	larvae/pupae	-24768.5000*	7229.34151	.032	-46950.1050	-2586.8950
	substrate	15388.0267	7229.34151	.164	-6793.5783	37569.6317
substrate	larvae/pupae	-40156.5267*	7229.34151	.003	-62338.1317	-17974.9217
	residues	-15388.0267	7229.34151	.164	-37569.6317	6793.5783

Based on observed means.

The error term is Mean Square(Error) = 78395067.955.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	13.332[a]	2	6.666	36.575	.000
Intercept	41.216	1	41.216	226.146	.000
SampleType	13.332	2	6.666	36.575	.000
Error	1.094	6	.182		
Total	55.642	9			
Corrected Total	14.426	8			

a. R Squared = .924 (Adjusted R Squared = .899)

Multiple Comparisons

Dependent Variable: Food - Cr

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-2.9367*	.34857	.000	-4.0062	-1.8671
	substrate	-1.9133*	.34857	.004	-2.9829	-.8438
residues	larvae/pupae	2.9367*	.34857	.000	1.8671	4.0062
	substrate	1.0233	.34857	.059	-.0462	2.0929
substrate	larvae/pupae	1.9133*	.34857	.004	.8438	2.9829
	residues	-1.0233	.34857	.059	-2.0929	.0462

Based on observed means.

The error term is Mean Square(Error) = .182.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	48390.886[a]	2	24195.443	29.180	.001
Intercept	112667.636	1	112667.636	135.880	.000
SampleType	48390.886	2	24195.443	29.180	.001
Error	4975.016	6	829.169		
Total	166033.538	9			
Corrected Total	53365.902	8			

a. R Squared = .907 (Adjusted R Squared = .876)

Multiple Comparisons

Dependent Variable: Food - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	145.9300*	23.51126	.002	73.7910	218.0690
	substrate	163.6500*	23.51126	.001	91.5110	235.7890
residues	larvae/pupae	-145.9300*	23.51126	.002	-218.0690	-73.7910
	substrate	17.7200	23.51126	.743	-54.4190	89.8590
substrate	larvae/pupae	-163.6500*	23.51126	.001	-235.7890	-91.5110
	residues	-17.7200	23.51126	.743	-89.8590	54.4190

Based on observed means.

The error term is Mean Square(Error) = 829.169.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14006.634[a]	2	7003.317	18.012	.003
Intercept	82708.008	1	82708.008	212.713	.000
SampleType	14006.634	2	7003.317	18.012	.003
Error	2332.945	6	388.824		
Total	99047.588	9			
Corrected Total	16339.579	8			

a. R Squared = .857 (Adjusted R Squared = .810)

Multiple Comparisons

Dependent Variable: Food - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-94.4133*	16.10019	.003	-143.8131	-45.0135
	substrate	-29.3767	16.10019	.240	-78.7765	20.0231
residues	larvae/pupae	94.4133*	16.10019	.003	45.0135	143.8131
	substrate	65.0367*	16.10019	.016	15.6369	114.4365
substrate	larvae/pupae	29.3767	16.10019	.240	-20.0231	78.7765
	residues	-65.0367*	16.10019	.016	-114.4365	-15.6369

Based on observed means.

The error term is Mean Square(Error) = 388.824.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.007[a]	2	.004	13.480	.006
Intercept	.047	1	.047	169.000	.000
SampleType	.007	2	.004	13.480	.006
Error	.002	6	.000		
Total	.056	9			
Corrected Total	.009	8			

a. R Squared = .818 (Adjusted R Squared = .757)

Multiple Comparisons

Dependent Variable: Food - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0700*	.01361	.005	-.1118	-.0282
	substrate	-.0267	.01361	.203	-.0684	.0151
residues	larvae/pupae	.0700*	.01361	.005	.0282	.1118
	substrate	.0433*	.01361	.043	.0016	.0851
substrate	larvae/pupae	.0267	.01361	.203	-.0151	.0684
	residues	-.0433*	.01361	.043	-.0851	-.0016

Based on observed means.

The error term is Mean Square(Error) = .000.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11.299[a]	2	5.649	57.673	.000
Intercept	39.313	1	39.313	401.334	.000
SampleType	11.299	2	5.649	57.673	.000
Error	.588	6	.098		
Total	51.199	9			
Corrected Total	11.887	8			

a. R Squared = .951 (Adjusted R Squared = .934)

Multiple Comparisons

Dependent Variable: Food - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-2.7233*	.25555	.000	-3.5074	-1.9392
	substrate	-1.6567*	.25555	.002	-2.4408	-.8726
residues	larvae/pupae	2.7233*	.25555	.000	1.9392	3.5074
	substrate	1.0667*	.25555	.014	.2826	1.8508
substrate	larvae/pupae	1.6567*	.25555	.002	.8726	2.4408
	residues	-1.0667*	.25555	.014	-1.8508	-.2826

Based on observed means.

The error term is Mean Square(Error) = .098.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	23.886[a]	2	11.943	7.847	.021
Intercept	641.102	1	641.102	421.233	.000
SampleType	23.886	2	11.943	7.847	.021
Error	9.132	6	1.522		
Total	674.120	9			
Corrected Total	33.018	8			

a. R Squared = .723 (Adjusted R Squared = .631)

Multiple Comparisons

Dependent Variable: Food - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-2.0500	1.00730	.185	-5.1407	1.0407
	substrate	1.9400	1.00730	.212	-1.1507	5.0307
residues	larvae/pupae	2.0500	1.00730	.185	-1.0407	5.1407
	substrate	3.9900*	1.00730	.017	.8993	7.0807
substrate	larvae/pupae	-1.9400	1.00730	.212	-5.0307	1.1507
	residues	-3.9900*	1.00730	.017	-7.0807	-.8993

Based on observed means.

The error term is Mean Square(Error) = 1.522.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3824.798[a]	2	1912.399	32.218	.001
Intercept	11742.612	1	11742.612	197.827	.000
SampleType	3824.798	2	1912.399	32.218	.001
Error	356.148	6	59.358		
Total	15923.559	9			
Corrected Total	4180.947	8			

a. R Squared = .915 (Adjusted R Squared = .886)

Multiple Comparisons

Dependent Variable: Food - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	38.0933*	6.29063	.002	18.7920	57.3947
	substrate	47.7533*	6.29063	.001	28.4520	67.0547
residues	larvae/pupae	-38.0933*	6.29063	.002	-57.3947	-18.7920
	substrate	9.6600	6.29063	.341	-9.6414	28.9614
substrate	larvae/pupae	-47.7533*	6.29063	.001	-67.0547	-28.4520
	residues	-9.6600	6.29063	.341	-28.9614	9.6414

Based on observed means.

The error term is Mean Square(Error) = 59.358.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.001[a]	2	.001	6421.000	.000
Intercept	.005	1	.005	43681.000	.000
SampleType	.001	2	.001	6421.000	.000
Error	6.667E-7	6	1.111E-7		
Total	.006	9			
Corrected Total	.001	8			

a. R Squared = 1.000 (Adjusted R Squared = .999)

Multiple Comparisons

Dependent Variable: Food - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0303*	.00027	.000	-.0312	-.0295
	substrate	-.0103*	.00027	.000	-.0112	-.0095
residues	larvae/pupae	.0303*	.00027	.000	.0295	.0312
	substrate	.0200*	.00027	.000	.0192	.0208
substrate	larvae/pupae	.0103*	.00027	.000	.0095	.0112
	residues	-.0200*	.00027	.000	-.0208	-.0192

Based on observed means.

The error term is Mean Square(Error) = 1.11E-007.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Mo

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.177[a]	2	.088	59.827	.000
Intercept	1.579	1	1.579	1068.639	.000
SampleType	.177	2	.088	59.827	.000
Error	.009	6	.001		
Total	1.765	9			
Corrected Total	.186	8			

a. R Squared = .952 (Adjusted R Squared = .936)

Multiple Comparisons

Dependent Variable: Food - Mo

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.3367*	.03139	.000	-.4330	-.2404
	substrate	-.1100*	.03139	.030	-.2063	-.0137
residues	larvae/pupae	.3367*	.03139	.000	.2404	.4330
	substrate	.2267*	.03139	.001	.1304	.3230
substrate	larvae/pupae	.1100*	.03139	.030	.0137	.2063
	residues	-.2267*	.03139	.001	-.3230	-.1304

Based on observed means.

The error term is Mean Square(Error) = .001.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.064[a]	2	.032	77.541	.000
Intercept	.064	1	.064	156.108	.000
SampleType	.064	2	.032	77.541	.000
Error	.002	6	.000		
Total	.130	9			
Corrected Total	.066	8			

a. R Squared = .963 (Adjusted R Squared = .950)

Multiple Comparisons

Dependent Variable: Food - Cd

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	.1833*	.01656	.000	.1325	.2341
	substrate	.1733*	.01656	.000	.1225	.2241
residues	larvae/pupae	-.1833*	.01656	.000	-.2341	-.1325
	substrate	-.0100	.01656	.823	-.0608	.0408
substrate	larvae/pupae	-.1733*	.01656	.000	-.2241	-.1225
	residues	.0100	.01656	.823	-.0408	.0608

Based on observed means.

The error term is Mean Square(Error) = .000.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.091[a]	2	.046	1.767	.249
Intercept	.302	1	.302	11.685	.014
SampleType	.091	2	.046	1.767	.249
Error	.155	6	.026		
Total	.549	9			
Corrected Total	.247	8			

a. R Squared = .371 (Adjusted R Squared = .161)

Multiple Comparisons

Dependent Variable: Food - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	.1133	.13137	.681	-.2898	.5164
	substrate	.2467	.13137	.225	-.1564	.6498
residues	larvae/pupae	-.1133	.13137	.681	-.5164	.2898
	substrate	.1333	.13137	.595	-.2698	.5364
substrate	larvae/pupae	-.2467	.13137	.225	-.6498	.1564
	residues	-.1333	.13137	.595	-.5364	.2698

Based on observed means.

The error term is Mean Square(Error) = .026.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Na

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	52362429.450[a]	2	26181214.725	97.515	.000
Intercept	204163042.131	1	204163042.131	760.426	.000
SampleType	52362429.450	2	26181214.725	97.515	.000
Error	1610910.495	6	268485.083		
Total	258136382.076	9			
Corrected Total	53973339.945	8			

a. R Squared = .970 (Adjusted R Squared = .960)

Multiple Comparisons

Dependent Variable: Biosolids1 - Na

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-5790.2200*	423.07216	.000	-7088.3216	-4492.1184
	substrate	-3913.0633*	423.07216	.000	-5211.1649	-2614.9618
residues	larvae/pupae	5790.2200*	423.07216	.000	4492.1184	7088.3216
	substrate	1877.1567*	423.07216	.010	579.0551	3175.2582
substrate	larvae/pupae	3913.0633*	423.07216	.000	2614.9618	5211.1649
	residues	-1877.1567*	423.07216	.010	-3175.2582	-579.0551

Based on observed means.

The error term is Mean Square(Error) = 268485.083.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Mg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	13779387.011[a]	2	6889693.506	46.771	.000
Intercept	254297028.267	1	254297028.267	1726.289	.000
SampleType	13779387.011	2	6889693.506	46.771	.000
Error	883850.763	6	147308.460		
Total	268960266.041	9			
Corrected Total	14663237.774	8			

a. R Squared = .940 (Adjusted R Squared = .920)

Multiple Comparisons

Dependent Variable: Biosolids1 - Mg

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-2938.7933*	313.37779	.000	-3900.3225	-1977.2642
	substrate	-827.2800	313.37779	.085	-1788.8091	134.2491
residues	larvae/pupae	2938.7933*	313.37779	.000	1977.2642	3900.3225
	substrate	2111.5133*	313.37779	.001	1149.9842	3073.0425
substrate	larvae/pupae	827.2800	313.37779	.085	-134.2491	1788.8091
	residues	-2111.5133*	313.37779	.001	-3073.0425	-1149.9842

Based on observed means.

The error term is Mean Square(Error) = 147308.460.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	222724072.127[a]	2	111362036.064	228.682	.000
Intercept	471836305.616	1	471836305.616	968.917	.000
SampleType	222724072.127	2	111362036.064	228.682	.000
Error	2921838.538	6	486973.090		
Total	697482216.282	9			
Corrected Total	225645910.666	8			

a. R Squared = .987 (Adjusted R Squared = .983)

Multiple Comparisons

Dependent Variable: Biosolids1 - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-11943.3667*	569.77954	.000	-13691.6068	-10195.1266
	substrate	-8064.2967*	569.77954	.000	-9812.5368	-6316.0566
residues	larvae/pupae	11943.3667*	569.77954	.000	10195.1266	13691.6068
	substrate	3879.0700*	569.77954	.001	2130.8299	5627.3101
substrate	larvae/pupae	8064.2967*	569.77954	.000	6316.0566	9812.5368
	residues	-3879.0700*	569.77954	.001	-5627.3101	-2130.8299

Based on observed means.

The error term is Mean Square(Error) = 486973.090.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Si

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	138595.240[a]	2	69297.620	9.055	.015
Intercept	272560.565	1	272560.565	35.615	.001
SampleType	138595.240	2	69297.620	9.055	.015
Error	45917.856	6	7652.976		
Total	457073.662	9			
Corrected Total	184513.096	8			

a. R Squared = .751 (Adjusted R Squared = .668)

Multiple Comparisons

Dependent Variable: Biosolids1 - Si

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	303.8167*	71.42817	.013	84.6554	522.9779
	substrate	143.5900	71.42817	.190	-75.5713	362.7513
residues	larvae/pupae	-303.8167*	71.42817	.013	-522.9779	-84.6554
	substrate	-160.2267	71.42817	.142	-379.3879	58.9346
substrate	larvae/pupae	-143.5900	71.42817	.190	-362.7513	75.5713
	residues	160.2267	71.42817	.142	-58.9346	379.3879

Based on observed means.

The error term is Mean Square(Error) = 7652.976.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - S

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	84862732.451[a]	2	42431366.226	22.764	.002
Intercept	470764727.000	1	470764727.000	252.566	.000
SampleType	84862732.451	2	42431366.226	22.764	.002
Error	11183581.295	6	1863930.216		
Total	566811040.745	9			
Corrected Total	96046313.746	8			

a. R Squared = .884 (Adjusted R Squared = .845)

Multiple Comparisons

Dependent Variable: Biosolids1 - S

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-7083.5400*	1114.72873	.002	-10503.8339	-3663.2461
	substrate	-5732.4233*	1114.72873	.005	-9152.7172	-2312.1295
residues	larvae/pupae	7083.5400*	1114.72873	.002	3663.2461	10503.8339
	substrate	1351.1167	1114.72873	.489	-2069.1772	4771.4105
substrate	larvae/pupae	5732.4233*	1114.72873	.005	2312.1295	9152.7172
	residues	-1351.1167	1114.72873	.489	-4771.4105	2069.1772

Based on observed means.

The error term is Mean Square(Error) = 1863930.216.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - K

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	133288549.477[a]	2	66644274.739	98.001	.000
Intercept	311284035.319	1	311284035.319	457.745	.000
SampleType	133288549.477	2	66644274.739	98.001	.000
Error	4080228.588	6	680038.098		
Total	448652813.384	9			
Corrected Total	137368778.065	8			

a. R Squared = .970 (Adjusted R Squared = .960)

Multiple Comparisons

Dependent Variable: Biosolids1 - K

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	7977.9500*	673.31919	.000	5912.0218	10043.8782
	substrate	8337.3667*	673.31919	.000	6271.4385	10403.2948
residues	larvae/pupae	-7977.9500*	673.31919	.000	-10043.8782	-5912.0218
	substrate	359.4167	673.31919	.858	-1706.5115	2425.3448
substrate	larvae/pupae	-8337.3667*	673.31919	.000	-10403.2948	-6271.4385
	residues	-359.4167	673.31919	.858	-2425.3448	1706.5115

Based on observed means.

The error term is Mean Square(Error) = 680038.098.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Ca

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3637448430.466[a]	2	1818724215.233	86.958	.000
Intercept	5425066881.536	1	5425066881.536	259.387	.000
SampleType	3637448430.466	2	1818724215.233	86.958	.000
Error	125489871.788	6	20914978.631		
Total	9188005183.790	9			
Corrected Total	3762938302.254	8			

a. R Squared = .967 (Adjusted R Squared = .956)

Multiple Comparisons

Dependent Variable: Biosolids1 - Ca

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	42327.5767*	3734.07540	.000	30870.4079	53784.7454
	substrate	42958.4300*	3734.07540	.000	31501.2613	54415.5987
residues	larvae/pupae	-42327.5767*	3734.07540	.000	-53784.7454	-30870.4079
	substrate	630.8533	3734.07540	.984	-10826.3154	12088.0221
substrate	larvae/pupae	-42958.4300*	3734.07540	.000	-54415.5987	-31501.2613
	residues	-630.8533	3734.07540	.984	-12088.0221	10826.3154

Based on observed means.

The error term is Mean Square(Error) = 20914978.631.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	878.698[a]	2	439.349	432.019	.000
Intercept	1836.408	1	1836.408	1805.770	.000
SampleType	878.698	2	439.349	432.019	.000
Error	6.102	6	1.017		
Total	2721.208	9			
Corrected Total	884.800	8			

a. R Squared = .993 (Adjusted R Squared = .991)

Multiple Comparisons

Dependent Variable: Biosolids1 - Cr

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-23.7700*	.82339	.000	-26.2964	-21.2436
	substrate	-15.8333*	.82339	.000	-18.3597	-13.3069
residues	larvae/pupae	23.7700*	.82339	.000	21.2436	26.2964
	substrate	7.9367*	.82339	.000	5.4103	10.4631
substrate	larvae/pupae	15.8333*	.82339	.000	13.3069	18.3597
	residues	-7.9367*	.82339	.000	-10.4631	-5.4103

Based on observed means.

The error term is Mean Square(Error) = 1.017.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4451.668[a]	2	2225.834	8.132	.020
Intercept	97314.882	1	97314.882	355.550	.000
SampleType	4451.668	2	2225.834	8.132	.020
Error	1642.212	6	273.702		
Total	103408.763	9			
Corrected Total	6093.880	8			

a. R Squared = .731 (Adjusted R Squared = .641)

Multiple Comparisons

Dependent Variable: Biosolids1 - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	18.8900	13.50807	.399	-22.5565	60.3365
	substrate	53.6967*	13.50807	.017	12.2502	95.1431
residues	larvae/pupae	-18.8900	13.50807	.399	-60.3365	22.5565
	substrate	34.8067	13.50807	.093	-6.6398	76.2531
substrate	larvae/pupae	-53.6967*	13.50807	.017	-95.1431	-12.2502
	residues	-34.8067	13.50807	.093	-76.2531	6.6398

Based on observed means.

The error term is Mean Square(Error) = 273.702.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	129252537.719[a]	2	64626268.860	303.534	.000
Intercept	295622173.444	1	295622173.444	1388.467	.000
SampleType	129252537.719	2	64626268.860	303.534	.000
Error	1277476.205	6	212912.701		
Total	426152187.369	9			
Corrected Total	130530013.924	8			

a. R Squared = .990 (Adjusted R Squared = .987)

Multiple Comparisons

Dependent Variable: Biosolids1 - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-9108.7800*	376.75164	.000	-10264.7575	-7952.8025
	substrate	-6103.2167*	376.75164	.000	-7259.1942	-4947.2392
residues	larvae/pupae	9108.7800*	376.75164	.000	7952.8025	10264.7575
	substrate	3005.5633*	376.75164	.001	1849.5858	4161.5408
substrate	larvae/pupae	6103.2167*	376.75164	.000	4947.2392	7259.1942
	residues	-3005.5633*	376.75164	.001	-4161.5408	-1849.5858

Based on observed means.

The error term is Mean Square(Error) = 212912.701.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10.141[a]	2	5.070	299.237	.000
Intercept	21.038	1	21.038	1241.558	.000
SampleType	10.141	2	5.070	299.237	.000
Error	.102	6	.017		
Total	31.280	9			
Corrected Total	10.242	8			

a. R Squared = .990 (Adjusted R Squared = .987)

Multiple Comparisons

Dependent Variable: Biosolids1 - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-2.5700*	.10628	.000	-2.8961	-2.2439
	substrate	-1.6267*	.10628	.000	-1.9528	-1.3006
residues	larvae/pupae	2.5700*	.10628	.000	2.2439	2.8961
	substrate	.9433*	.10628	.000	.6172	1.2694
substrate	larvae/pupae	1.6267*	.10628	.000	1.3006	1.9528
	residues	-.9433*	.10628	.000	-1.2694	-.6172

Based on observed means.

The error term is Mean Square(Error) = .017.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	278.298[a]	2	139.149	306.999	.000
Intercept	567.710	1	567.710	1252.516	.000
SampleType	278.298	2	139.149	306.999	.000
Error	2.720	6	.453		
Total	848.727	9			
Corrected Total	281.017	8			

a. R Squared = .990 (Adjusted R Squared = .987)

Multiple Comparisons

Dependent Variable: Biosolids1 - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-13.4400*	.54970	.000	-15.1266	-11.7534
	substrate	-8.6367*	.54970	.000	-10.3233	-6.9500
residues	larvae/pupae	13.4400*	.54970	.000	11.7534	15.1266
	substrate	4.8033*	.54970	.000	3.1167	6.4900
substrate	larvae/pupae	8.6367*	.54970	.000	6.9500	10.3233
	residues	-4.8033*	.54970	.000	-6.4900	-3.1167

Based on observed means.

The error term is Mean Square(Error) = .453.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	373817.305[a]	2	186908.652	290.957	.000
Intercept	855822.345	1	855822.345	1332.244	.000
SampleType	373817.305	2	186908.652	290.957	.000
Error	3854.350	6	642.392		
Total	1233494.000	9			
Corrected Total	377671.655	8			

a. R Squared = .990 (Adjusted R Squared = .986)

Multiple Comparisons

Dependent Variable: Biosolids1 - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-490.9133*	20.69447	.000	-554.4097	-427.4170
	substrate	-323.9533*	20.69447	.000	-387.4497	-260.4570
residues	larvae/pupae	490.9133*	20.69447	.000	427.4170	554.4097
	substrate	166.9600*	20.69447	.000	103.4637	230.4563
substrate	larvae/pupae	323.9533*	20.69447	.000	260.4570	387.4497
	residues	-166.9600*	20.69447	.000	-230.4563	-103.4637

Based on observed means.

The error term is Mean Square(Error) = 642.392.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	492824.950[a]	2	246412.475	123.020	.000
Intercept	2110986.213	1	2110986.213	1053.895	.000
SampleType	492824.950	2	246412.475	123.020	.000
Error	12018.192	6	2003.032		
Total	2615829.354	9			
Corrected Total	504843.141	8			

a. R Squared = .976 (Adjusted R Squared = .968)

Multiple Comparisons

Dependent Variable: Biosolids1 - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-570.7067*	36.54250	.000	-682.8291	-458.5842
	substrate	-331.5367*	36.54250	.000	-443.6591	-219.4142
residues	larvae/pupae	570.7067*	36.54250	.000	458.5842	682.8291
	substrate	239.1700*	36.54250	.001	127.0476	351.2924
substrate	larvae/pupae	331.5367*	36.54250	.000	219.4142	443.6591
	residues	-239.1700*	36.54250	.001	-351.2924	-127.0476

Based on observed means.

The error term is Mean Square(Error) = 2003.032.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	26.649[a]	2	13.324	111.016	.000
Intercept	75.980	1	75.980	633.052	.000
SampleType	26.649	2	13.324	111.016	.000
Error	.720	6	.120		
Total	103.349	9			
Corrected Total	27.369	8			

a. R Squared = .974 (Adjusted R Squared = .965)

Multiple Comparisons

Dependent Variable: Biosolids1 - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-4.1000*	.28287	.000	-4.9679	-3.2321
	substrate	-2.8967*	.28287	.000	-3.7646	-2.0287
residues	larvae/pupae	4.1000*	.28287	.000	3.2321	4.9679
	substrate	1.2033*	.28287	.013	.3354	2.0713
substrate	larvae/pupae	2.8967*	.28287	.000	2.0287	3.7646
	residues	-1.2033*	.28287	.013	-2.0713	-.3354

Based on observed means.

The error term is Mean Square(Error) = .120.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Mo

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	36.089[a]	2	18.045	260.091	.000
Intercept	143.441	1	143.441	2067.529	.000
SampleType	36.089	2	18.045	260.091	.000
Error	.416	6	.069		
Total	179.946	9			
Corrected Total	36.505	8			

a. R Squared = .989 (Adjusted R Squared = .985)

Multiple Comparisons

Dependent Variable: Biosolids1 - Mo

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-4.8433*	.21506	.000	-5.5032	-4.1835
	substrate	-3.0933*	.21506	.000	-3.7532	-2.4335
residues	larvae/pupae	4.8433*	.21506	.000	4.1835	5.5032
	substrate	1.7500*	.21506	.000	1.0901	2.4099
substrate	larvae/pupae	3.0933*	.21506	.000	2.4335	3.7532
	residues	-1.7500*	.21506	.000	-2.4099	-1.0901

Based on observed means.

The error term is Mean Square(Error) = .069.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.328[a]	2	.164	3.241	.111
Intercept	6.725	1	6.725	132.854	.000
SampleType	.328	2	.164	3.241	.111
Error	.304	6	.051		
Total	7.357	9			
Corrected Total	.632	8			

a. R Squared = .519 (Adjusted R Squared = .359)

Multiple Comparisons

Dependent Variable: Biosolids1 - Cd

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.2600	.18371	.392	-.3037	.8237
	substrate	.4667	.18371	.097	-.0970	1.0303
residues	larvae/pupae	-.2600	.18371	.392	-.8237	.3037
	substrate	.2067	.18371	.535	-.3570	.7703
substrate	larvae/pupae	-.4667	.18371	.097	-1.0303	.0970
	residues	-.2067	.18371	.535	-.7703	.3570

Based on observed means.

The error term is Mean Square(Error) = .051.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1342.564[a]	2	671.282	25.880	.001
Intercept	5958.296	1	5958.296	229.707	.000
SampleType	1342.564	2	671.282	25.880	.001
Error	155.632	6	25.939		
Total	7456.492	9			
Corrected Total	1498.196	8			

a. R Squared = .896 (Adjusted R Squared = .861)

Multiple Comparisons

Dependent Variable: Biosolids1 - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-29.9133*	4.15842	.001	-42.6725	-17.1542
	substrate	-15.3767*	4.15842	.024	-28.1358	-2.6175
residues	larvae/pupae	29.9133*	4.15842	.001	17.1542	42.6725
	substrate	14.5367*	4.15842	.030	1.7775	27.2958
substrate	larvae/pupae	15.3767*	4.15842	.024	2.6175	28.1358
	residues	-14.5367*	4.15842	.030	-27.2958	-1.7775

Based on observed means.

The error term is Mean Square(Error) = 25.939.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Na

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	45971942.849[a]	2	22985971.425	189.281	.000
Intercept	130683155.200	1	130683155.200	1076.130	.000
SampleType	45971942.849	2	22985971.425	189.281	.000
Error	728628.366	6	121438.061		
Total	177383726.415	9			
Corrected Total	46700571.215	8			

a. R Squared = .984 (Adjusted R Squared = .979)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Na

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-5524.7267*	284.53244	.000	-6397.7503	-4651.7030
	substrate	-3068.9867*	284.53244	.000	-3942.0103	-2195.9630
residues	larvae/pupae	5524.7267*	284.53244	.000	4651.7030	6397.7503
	substrate	2455.7400*	284.53244	.000	1582.7164	3328.7636
substrate	larvae/pupae	3068.9867*	284.53244	.000	2195.9630	3942.0103
	residues	-2455.7400*	284.53244	.000	-3328.7636	-1582.7164

Based on observed means.

The error term is Mean Square(Error) = 121438.061.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Mg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6499384.768[a]	2	3249692.384	19.798	.002
Intercept	170544097.624	1	170544097.624	1038.978	.000
SampleType	6499384.768	2	3249692.384	19.798	.002
Error	984876.334	6	164146.056		
Total	178028358.726	9			
Corrected Total	7484261.102	8			

a. R Squared = .868 (Adjusted R Squared = .825)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Mg

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-1822.4767*	330.80312	.004	-2837.4715	-807.4819
	substrate	-40.2467	330.80312	.992	-1055.2415	974.7481
residues	larvae/pupae	1822.4767*	330.80312	.004	807.4819	2837.4715
	substrate	1782.2300*	330.80312	.004	767.2352	2797.2248
substrate	larvae/pupae	40.2467	330.80312	.992	-974.7481	1055.2415
	residues	-1782.2300*	330.80312	.004	-2797.2248	-767.2352

Based on observed means.

The error term is Mean Square(Error) = 164146.056.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	127382091.855[a]	2	63691045.928	162.180	.000
Intercept	248447579.328	1	248447579.328	632.635	.000
SampleType	127382091.855	2	63691045.928	162.180	.000
Error	2356310.797	6	392718.466		
Total	378185981.980	9			
Corrected Total	129738402.652	8			

a. R Squared = .982 (Adjusted R Squared = .976)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-8921.9400*	511.67598	.000	-10491.9024	-7351.9776
	substrate	-6458.5400*	511.67598	.000	-8028.5024	-4888.5776
residues	larvae/pupae	8921.9400*	511.67598	.000	7351.9776	10491.9024
	substrate	2463.4000*	511.67598	.007	893.4376	4033.3624
substrate	larvae/pupae	6458.5400*	511.67598	.000	4888.5776	8028.5024
	residues	-2463.4000*	511.67598	.007	-4033.3624	-893.4376

Based on observed means.

The error term is Mean Square(Error) = 392718.466.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Si

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	97481.587[a]	2	48740.794	31.594	.001
Intercept	88220.880	1	88220.880	57.185	.000
SampleType	97481.587	2	48740.794	31.594	.001
Error	9256.428	6	1542.738		
Total	194958.896	9			
Corrected Total	106738.016	8			

a. R Squared = .913 (Adjusted R Squared = .884)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Si

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	213.9133*	32.07011	.001	115.5134	312.3132
	substrate	227.0467*	32.07011	.001	128.6468	325.4466
residues	larvae/pupae	-213.9133*	32.07011	.001	-312.3132	-115.5134
	substrate	13.1333	32.07011	.913	-85.2666	111.5332
substrate	larvae/pupae	-227.0467*	32.07011	.001	-325.4466	-128.6468
	residues	-13.1333	32.07011	.913	-111.5332	85.2666

Based on observed means.

The error term is Mean Square(Error) = 1542.738.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - S

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	58761824.748[a]	2	29380912.374	153.020	.000
Intercept	270843491.298	1	270843491.298	1410.590	.000
SampleType	58761824.748	2	29380912.374	153.020	.000
Error	1152043.710	6	192007.285		
Total	330757359.755	9			
Corrected Total	59913868.457	8			

a. R Squared = .981 (Adjusted R Squared = .974)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - S

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-6185.1433*	357.77766	.000	-7282.9035	-5087.3832
	substrate	-3922.5800*	357.77766	.000	-5020.3401	-2824.8199
residues	larvae/pupae	6185.1433*	357.77766	.000	5087.3832	7282.9035
	substrate	2262.5633*	357.77766	.002	1164.8032	3360.3235
substrate	larvae/pupae	3922.5800*	357.77766	.000	2824.8199	5020.3401
	residues	-2262.5633*	357.77766	.002	-3360.3235	-1164.8032

Based on observed means.

The error term is Mean Square(Error) = 192007.285.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - K

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	105250340.103[a]	2	52625170.051	30.493	.001
Intercept	1092381601.099	1	1092381601.099	632.968	.000
SampleType	105250340.103	2	52625170.051	30.493	.001
Error	10354844.841	6	1725807.474		
Total	1207986786.043	9			
Corrected Total	115605184.944	8			

a. R Squared = .910 (Adjusted R Squared = .881)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - K

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-7588.7600*	1072.63149	.001	-10879.8880	-4297.6320
	substrate	-723.0267	1072.63149	.786	-4014.1546	2568.1013
residues	larvae/pupae	7588.7600*	1072.63149	.001	4297.6320	10879.8880
	substrate	6865.7333*	1072.63149	.002	3574.6054	10156.8613
substrate	larvae/pupae	723.0267	1072.63149	.786	-2568.1013	4014.1546
	residues	-6865.7333*	1072.63149	.002	-10156.8613	-3574.6054

Based on observed means.

The error term is Mean Square(Error) = 1725807.474.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Ca

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4381135014.506[a]	2	2190567507.253	23.239	.001
Intercept	15526358675.136	1	15526358675.136	164.711	.000
SampleType	4381135014.506	2	2190567507.253	23.239	.001
Error	565584641.197	6	94264106.866		
Total	20473078330.839	9			
Corrected Total	4946719655.703	8			

a. R Squared = .886 (Adjusted R Squared = .848)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Ca

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	41882.0733*	7927.34116	.004	17558.8137	66205.3329
	substrate	50521.2067*	7927.34116	.002	26197.9471	74844.4663
residues	larvae/pupae	-41882.0733*	7927.34116	.004	-66205.3329	-17558.8137
	substrate	8639.1333	7927.34116	.554	-15684.1263	32962.3929
substrate	larvae/pupae	-50521.2067*	7927.34116	.002	-74844.4663	-26197.9471
	residues	-8639.1333	7927.34116	.554	-32962.3929	15684.1263

Based on observed means.

The error term is Mean Square(Error) = 94264106.866.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	637.544[a]	2	318.772	141.028	.000
Intercept	1097.155	1	1097.155	485.393	.000
SampleType	637.544	2	318.772	141.028	.000
Error	13.562	6	2.260		
Total	1748.262	9			
Corrected Total	651.106	8			

a. R Squared = .979 (Adjusted R Squared = .972)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Cr

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-20.5000*	1.22756	.000	-24.2665	-16.7335
	substrate	-12.1433*	1.22756	.000	-15.9098	-8.3769
residues	larvae/pupae	20.5000*	1.22756	.000	16.7335	24.2665
	substrate	8.3567*	1.22756	.001	4.5902	12.1231
substrate	larvae/pupae	12.1433*	1.22756	.000	8.3769	15.9098
	residues	-8.3567*	1.22756	.001	-12.1231	-4.5902

Based on observed means.

The error term is Mean Square(Error) = 2.260.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9098.761[a]	2	4549.380	28.306	.001
Intercept	99567.595	1	99567.595	619.511	.000
SampleType	9098.761	2	4549.380	28.306	.001
Error	964.319	6	160.720		
Total	109630.674	9			
Corrected Total	10063.079	8			

a. R Squared = .904 (Adjusted R Squared = .872)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	39.0833*	10.35116	.022	7.3231	70.8435
	substrate	77.8833*	10.35116	.001	46.1231	109.6435
residues	larvae/pupae	-39.0833*	10.35116	.022	-70.8435	-7.3231
	substrate	38.8000*	10.35116	.022	7.0398	70.5602
substrate	larvae/pupae	-77.8833*	10.35116	.001	-109.6435	-46.1231
	residues	-38.8000*	10.35116	.022	-70.5602	-7.0398

Based on observed means.

The error term is Mean Square(Error) = 160.720.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	74754305.432[a]	2	37377152.716	125.840	.000
Intercept	151137026.688	1	151137026.688	508.843	.000
SampleType	74754305.432	2	37377152.716	125.840	.000
Error	1782127.104	6	297021.184		
Total	227673459.225	9			
Corrected Total	76536432.536	8			

a. R Squared = .977 (Adjusted R Squared = .969)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-6873.8133*	444.98778	.000	-8239.1580	-5508.4686
	substrate	-4829.8067*	444.98778	.000	-6195.1514	-3464.4620
residues	larvae/pupae	6873.8133*	444.98778	.000	5508.4686	8239.1580
	substrate	2044.0067*	444.98778	.009	678.6620	3409.3514
substrate	larvae/pupae	4829.8067*	444.98778	.000	3464.4620	6195.1514
	residues	-2044.0067*	444.98778	.009	-3409.3514	-678.6620

Based on observed means.

The error term is Mean Square(Error) = 297021.184.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5.561[a]	2	2.781	359.579	.000
Intercept	10.519	1	10.519	1360.243	.000
SampleType	5.561	2	2.781	359.579	.000
Error	.046	6	.008		
Total	16.127	9			
Corrected Total	5.608	8			

a. R Squared = .992 (Adjusted R Squared = .989)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-1.8867*	.07180	.000	-2.1070	-1.6664
	substrate	-1.2767*	.07180	.000	-1.4970	-1.0564
residues	larvae/pupae	1.8867*	.07180	.000	1.6664	2.1070
	substrate	.6100*	.07180	.000	.3897	.8303
substrate	larvae/pupae	1.2767*	.07180	.000	1.0564	1.4970
	residues	-.6100*	.07180	.000	-.8303	-.3897

Based on observed means.

The error term is Mean Square(Error) = .008.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	211.423[a]	2	105.711	131.624	.000
Intercept	362.395	1	362.395	451.226	.000
SampleType	211.423	2	105.711	131.624	.000
Error	4.819	6	.803		
Total	578.636	9			
Corrected Total	216.242	8			

a. R Squared = .978 (Adjusted R Squared = .970)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-11.8233*	.73173	.000	-14.0685	-9.5782
	substrate	-6.8433*	.73173	.000	-9.0885	-4.5982
residues	larvae/pupae	11.8233*	.73173	.000	9.5782	14.0685
	substrate	4.9800*	.73173	.001	2.7349	7.2251
substrate	larvae/pupae	6.8433*	.73173	.000	4.5982	9.0885
	residues	-4.9800*	.73173	.001	-7.2251	-2.7349

Based on observed means.

The error term is Mean Square(Error) = .803.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	179570.900[a]	2	89785.450	466.706	.000
Intercept	373879.255	1	373879.255	1943.429	.000
SampleType	179570.900	2	89785.450	466.706	.000
Error	1154.287	6	192.381		
Total	554604.443	9			
Corrected Total	180725.187	8			

a. R Squared = .994 (Adjusted R Squared = .991)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-334.1133*	11.32493	.000	-368.8613	-299.3653
	substrate	-244.9133*	11.32493	.000	-279.6613	-210.1653
residues	larvae/pupae	334.1133*	11.32493	.000	299.3653	368.8613
	substrate	89.2000*	11.32493	.001	54.4520	123.9480
substrate	larvae/pupae	244.9133*	11.32493	.000	210.1653	279.6613
	residues	-89.2000*	11.32493	.001	-123.9480	-54.4520

Based on observed means.

The error term is Mean Square(Error) = 192.381.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	311928.306[a]	2	155964.153	78.755	.000
Intercept	1093997.457	1	1093997.457	552.421	.000
SampleType	311928.306	2	155964.153	78.755	.000
Error	11882.224	6	1980.371		
Total	1417807.987	9			
Corrected Total	323810.530	8			

a. R Squared = .963 (Adjusted R Squared = .951)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-434.1500*	36.33521	.000	-545.6364	-322.6636
	substrate	-337.9033*	36.33521	.000	-449.3897	-226.4169
residues	larvae/pupae	434.1500*	36.33521	.000	322.6636	545.6364
	substrate	96.2467	36.33521	.084	-15.2397	207.7331
substrate	larvae/pupae	337.9033*	36.33521	.000	226.4169	449.3897
	residues	-96.2467	36.33521	.084	-207.7331	15.2397

Based on observed means.

The error term is Mean Square(Error) = 1980.371.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	19.943[a]	2	9.971	225.766	.000
Intercept	40.111	1	40.111	908.176	.000
SampleType	19.943	2	9.971	225.766	.000
Error	.265	6	.044		
Total	60.319	9			
Corrected Total	20.208	8			

a. R Squared = .987 (Adjusted R Squared = .983)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-3.5367*	.17159	.000	-4.0632	-3.0102
	substrate	-2.5367*	.17159	.000	-3.0632	-2.0102
residues	larvae/pupae	3.5367*	.17159	.000	3.0102	4.0632
	substrate	1.0000*	.17159	.003	.4735	1.5265
substrate	larvae/pupae	2.5367*	.17159	.000	2.0102	3.0632
	residues	-1.0000*	.17159	.003	-1.5265	-.4735

Based on observed means.

The error term is Mean Square(Error) = .044.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Mo

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	29.184[a]	2	14.592	100.203	.000
Intercept	78.736	1	78.736	540.687	.000
SampleType	29.184	2	14.592	100.203	.000
Error	.874	6	.146		
Total	108.793	9			
Corrected Total	30.057	8			

a. R Squared = .971 (Adjusted R Squared = .961)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Mo

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-4.3033*	.31158	.000	-5.2593	-3.3473
	substrate	-2.9900*	.31158	.000	-3.9460	-2.0340
residues	larvae/pupae	4.3033*	.31158	.000	3.3473	5.2593
	substrate	1.3133*	.31158	.013	.3573	2.2693
substrate	larvae/pupae	2.9900*	.31158	.000	2.0340	3.9460
	residues	-1.3133*	.31158	.013	-2.2693	-.3573

Based on observed means.

The error term is Mean Square(Error) = .146.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.481[a]	2	.240	2.046	.210
Intercept	2.901	1	2.901	24.697	.003
SampleType	.481	2	.240	2.046	.210
Error	.705	6	.117		
Total	4.087	9			
Corrected Total	1.186	8			

a. R Squared = .405 (Adjusted R Squared = .207)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Cd

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.3300	.27985	.506	-1.1887	.5287
	substrate	-.5633	.27985	.190	-1.4220	.2953
residues	larvae/pupae	.3300	.27985	.506	-.5287	1.1887
	substrate	-.2333	.27985	.698	-1.0920	.6253
substrate	larvae/pupae	.5633	.27985	.190	-.2953	1.4220
	residues	.2333	.27985	.698	-.6253	1.0920

Based on observed means.

The error term is Mean Square(Error) = .117.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1083.089[a]	2	541.544	62.120	.000
Intercept	2381.765	1	2381.765	273.209	.000
SampleType	1083.089	2	541.544	62.120	.000
Error	52.307	6	8.718		
Total	3517.161	9			
Corrected Total	1135.395	8			

a. R Squared = .954 (Adjusted R Squared = .939)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-25.9100*	2.41078	.000	-33.3069	-18.5131
	substrate	-19.1233*	2.41078	.001	-26.5203	-11.7264
residues	larvae/pupae	25.9100*	2.41078	.000	18.5131	33.3069
	substrate	6.7867	2.41078	.069	-.6103	14.1836
substrate	larvae/pupae	19.1233*	2.41078	.001	11.7264	26.5203
	residues	-6.7867	2.41078	.069	-14.1836	.6103

Based on observed means.

The error term is Mean Square(Error) = 8.718.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Na

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	153884.673[a]	2	76942.337	2.736	.143
Intercept	10491121.000	1	10491121.000	373.001	.000
SampleType	153884.673	2	76942.337	2.736	.143
Error	168757.721	6	28126.287		
Total	10813763.394	9			
Corrected Total	322642.394	8			

a. R Squared = .477 (Adjusted R Squared = .303)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Na

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-252.2933	136.93377	.235	-672.4437	167.8571
	substrate	44.7433	136.93377	.943	-375.4071	464.8937
residues	larvae/pupae	252.2933	136.93377	.235	-167.8571	672.4437
	substrate	297.0367	136.93377	.156	-123.1137	717.1871
substrate	larvae/pupae	-44.7433	136.93377	.943	-464.8937	375.4071
	residues	-297.0367	136.93377	.156	-717.1871	123.1137

Based on observed means.

The error term is Mean Square(Error) = 28126.287.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Mg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	93056783.406[a]	2	46528391.703	23.923	.001
Intercept	522452658.510	1	522452658.510	268.628	.000
SampleType	93056783.406	2	46528391.703	23.923	.001
Error	11669347.413	6	1944891.236		
Total	627178789.329	9			
Corrected Total	104726130.819	8			

a. R Squared = .889 (Adjusted R Squared = .851)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Mg

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-7849.1500*	1138.68088	.001	-11342.9356	-4355.3644
	substrate	-3357.5433	1138.68088	.058	-6851.3290	136.2423
residues	larvae/pupae	7849.1500*	1138.68088	.001	4355.3644	11342.9356
	substrate	4491.6067*	1138.68088	.018	997.8210	7985.3923
substrate	larvae/pupae	3357.5433	1138.68088	.058	-136.2423	6851.3290
	residues	-4491.6067*	1138.68088	.018	-7985.3923	-997.8210

Based on observed means.

The error term is Mean Square(Error) = 1944891.236.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	170847682.572[a]	2	85423841.286	1020.810	.000
Intercept	260847371.593	1	260847371.593	3117.111	.000
SampleType	170847682.572	2	85423841.286	1020.810	.000
Error	502094.467	6	83682.411		
Total	432197148.632	9			
Corrected Total	171349777.039	8			

a. R Squared = .997 (Adjusted R Squared = .996)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-10646.8500*	236.19542	.000	-11371.5624	-9922.1376
	substrate	-4685.2400*	236.19542	.000	-5409.9524	-3960.5276
residues	larvae/pupae	10646.8500*	236.19542	.000	9922.1376	11371.5624
	substrate	5961.6100*	236.19542	.000	5236.8976	6686.3224
substrate	larvae/pupae	4685.2400*	236.19542	.000	3960.5276	5409.9524
	residues	-5961.6100*	236.19542	.000	-6686.3224	-5236.8976

Based on observed means.

The error term is Mean Square(Error) = 83682.411.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Si

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	56387.574[a]	2	28193.787	14.768	.005
Intercept	449427.221	1	449427.221	235.414	.000
SampleType	56387.574	2	28193.787	14.768	.005
Error	11454.576	6	1909.096		
Total	517269.372	9			
Corrected Total	67842.151	8			

a. R Squared = .831 (Adjusted R Squared = .775)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Si

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	80.2467	35.67535	.141	-29.2151	189.7084
	substrate	-112.7300*	35.67535	.045	-222.1918	-3.2682
residues	larvae/pupae	-80.2467	35.67535	.141	-189.7084	29.2151
	substrate	-192.9767*	35.67535	.004	-302.4384	-83.5149
substrate	larvae/pupae	112.7300*	35.67535	.045	3.2682	222.1918
	residues	192.9767*	35.67535	.004	83.5149	302.4384

Based on observed means.

The error term is Mean Square(Error) = 1909.096.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - S

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8822127.979[a]	2	4411063.990	48.689	.000
Intercept	104193260.400	1	104193260.400	1150.089	.000
SampleType	8822127.979	2	4411063.990	48.689	.000
Error	543574.914	6	90595.819		
Total	113558963.294	9			
Corrected Total	9365702.894	8			

a. R Squared = .942 (Adjusted R Squared = .923)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - S

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-2311.9667*	245.75844	.000	-3066.0211	-1557.9123
	substrate	-521.8133	245.75844	.165	-1275.8677	232.2411
residues	larvae/pupae	2311.9667*	245.75844	.000	1557.9123	3066.0211
	substrate	1790.1533*	245.75844	.001	1036.0989	2544.2077
substrate	larvae/pupae	521.8133	245.75844	.165	-232.2411	1275.8677
	residues	-1790.1533*	245.75844	.001	-2544.2077	-1036.0989

Based on observed means.

The error term is Mean Square(Error) = 90595.819.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - K

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	813394629.089[a]	2	406697314.544	199.670	.000
Intercept	3423471979.063	1	3423471979.063	1680.774	.000
SampleType	813394629.089	2	406697314.544	199.670	.000
Error	12221056.935	6	2036842.823		
Total	4249087665.087	9			
Corrected Total	825615686.024	8			

a. R Squared = .985 (Adjusted R Squared = .980)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - K

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-23215.1633*	1165.28761	.000	-26790.5857	-19639.7409
	substrate	-10029.7800*	1165.28761	.000	-13605.2024	-6454.3576
residues	larvae/pupae	23215.1633*	1165.28761	.000	19639.7409	26790.5857
	substrate	13185.3833*	1165.28761	.000	9609.9609	16760.8057
substrate	larvae/pupae	10029.7800*	1165.28761	.000	6454.3576	13605.2024
	residues	-13185.3833*	1165.28761	.000	-16760.8057	-9609.9609

Based on observed means.

The error term is Mean Square(Error) = 2036842.823.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Ca

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1155134998.129[a]	2	577567499.065	132.349	.000
Intercept	980587054.587	1	980587054.587	224.700	.000
SampleType	1155134998.129	2	577567499.065	132.349	.000
Error	26183856.191	6	4363976.032		
Total	2161905908.907	9			
Corrected Total	1181318854.320	8			

a. R Squared = .978 (Adjusted R Squared = .970)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Ca

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	24832.1800*	1705.67211	.000	19598.7096	30065.6504
	substrate	23144.0733*	1705.67211	.000	17910.6029	28377.5438
residues	larvae/pupae	-24832.1800*	1705.67211	.000	-30065.6504	-19598.7096
	substrate	-1688.1067	1705.67211	.609	-6921.5771	3545.3638
substrate	larvae/pupae	-23144.0733*	1705.67211	.000	-28377.5438	-17910.6029
	residues	1688.1067	1705.67211	.609	-3545.3638	6921.5771

Based on observed means.

The error term is Mean Square(Error) = 4363976.032.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	78.823[a]	2	39.412	227.141	.000
Intercept	119.392	1	119.392	688.095	.000
SampleType	78.823	2	39.412	227.141	.000
Error	1.041	6	.174		
Total	199.256	9			
Corrected Total	79.864	8			

a. R Squared = .987 (Adjusted R Squared = .983)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Cr

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-7.2233*	.34011	.000	-8.2669	-6.1798
	substrate	-3.0833*	.34011	.000	-4.1269	-2.0398
residues	larvae/pupae	7.2233*	.34011	.000	6.1798	8.2669
	substrate	4.1400*	.34011	.000	3.0965	5.1835
substrate	larvae/pupae	3.0833*	.34011	.000	2.0398	4.1269
	residues	-4.1400*	.34011	.000	-5.1835	-3.0965

Based on observed means.

The error term is Mean Square(Error) = .174.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	159370.469[a]	2	79685.234	23.501	.001
Intercept	928351.520	1	928351.520	273.795	.000
SampleType	159370.469	2	79685.234	23.501	.001
Error	20344.056	6	3390.676		
Total	1108066.045	9			
Corrected Total	179714.524	8			

a. R Squared = .887 (Adjusted R Squared = .849)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	250.5933*	47.54420	.005	104.7147	396.4720
	substrate	305.8167*	47.54420	.002	159.9380	451.6953
residues	larvae/pupae	-250.5933*	47.54420	.005	-396.4720	-104.7147
	substrate	55.2233	47.54420	.515	-90.6553	201.1020
substrate	larvae/pupae	-305.8167*	47.54420	.002	-451.6953	-159.9380
	residues	-55.2233	47.54420	.515	-201.1020	90.6553

Based on observed means.

The error term is Mean Square(Error) = 3390.676.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5094643.110[a]	2	2547321.555	167.164	.000
Intercept	8866975.211	1	8866975.211	581.881	.000
SampleType	5094643.110	2	2547321.555	167.164	.000
Error	91430.852	6	15238.475		
Total	14053049.173	9			
Corrected Total	5186073.962	8			

a. R Squared = .982 (Adjusted R Squared = .976)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-1837.6233*	100.79178	.000	-2146.8802	-1528.3665
	substrate	-797.6633*	100.79178	.001	-1106.9202	-488.4065
residues	larvae/pupae	1837.6233*	100.79178	.000	1528.3665	2146.8802
	substrate	1039.9600*	100.79178	.000	730.7031	1349.2169
substrate	larvae/pupae	797.6633*	100.79178	.001	488.4065	1106.9202
	residues	-1039.9600*	100.79178	.000	-1349.2169	-730.7031

Based on observed means.

The error term is Mean Square(Error) = 15238.475.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.345[a]	2	.672	991.934	.000
Intercept	2.151	1	2.151	3173.770	.000
SampleType	1.345	2	.672	991.934	.000
Error	.004	6	.001		
Total	3.500	9			
Corrected Total	1.349	8			

a. R Squared = .997 (Adjusted R Squared = .996)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.9467*	.02126	.000	-1.0119	-.8814
	substrate	-.4600*	.02126	.000	-.5252	-.3948
residues	larvae/pupae	.9467*	.02126	.000	.8814	1.0119
	substrate	.4867*	.02126	.000	.4214	.5519
substrate	larvae/pupae	.4600*	.02126	.000	.3948	.5252
	residues	-.4867*	.02126	.000	-.5519	-.4214

Based on observed means.

The error term is Mean Square(Error) = .001.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	39.218[a]	2	19.609	532.375	.000
Intercept	61.727	1	61.727	1675.852	.000
SampleType	39.218	2	19.609	532.375	.000
Error	.221	6	.037		
Total	101.167	9			
Corrected Total	39.439	8			

a. R Squared = .994 (Adjusted R Squared = .993)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-5.1100*	.15670	.000	-5.5908	-4.6292
	substrate	-2.3967*	.15670	.000	-2.8775	-1.9159
residues	larvae/pupae	5.1100*	.15670	.000	4.6292	5.5908
	substrate	2.7133*	.15670	.000	2.2325	3.1941
substrate	larvae/pupae	2.3967*	.15670	.000	1.9159	2.8775
	residues	-2.7133*	.15670	.000	-3.1941	-2.2325

Based on observed means.

The error term is Mean Square(Error) = .037.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5884.834[a]	2	2942.417	380.078	.000
Intercept	12967.136	1	12967.136	1674.992	.000
SampleType	5884.834	2	2942.417	380.078	.000
Error	46.450	6	7.742		
Total	18898.420	9			
Corrected Total	5931.284	8			

a. R Squared = .992 (Adjusted R Squared = .990)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-62.3933*	2.27180	.000	-69.3638	-55.4228
	substrate	-26.4300*	2.27180	.000	-33.4005	-19.4595
residues	larvae/pupae	62.3933*	2.27180	.000	55.4228	69.3638
	substrate	35.9633*	2.27180	.000	28.9928	42.9338
substrate	larvae/pupae	26.4300*	2.27180	.000	19.4595	33.4005
	residues	-35.9633*	2.27180	.000	-42.9338	-28.9928

Based on observed means.

The error term is Mean Square(Error) = 7.742.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	82449.836[a]	2	41224.918	34.097	.001
Intercept	392151.488	1	392151.488	324.345	.000
SampleType	82449.836	2	41224.918	34.097	.001
Error	7254.347	6	1209.058		
Total	481855.672	9			
Corrected Total	89704.183	8			

a. R Squared = .919 (Adjusted R Squared = .892)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-231.0967*	28.39082	.000	-318.2075	-143.9858
	substrate	-81.3333	28.39082	.064	-168.4442	5.7775
residues	larvae/pupae	231.0967*	28.39082	.000	143.9858	318.2075
	substrate	149.7633*	28.39082	.005	62.6525	236.8742
substrate	larvae/pupae	81.3333	28.39082	.064	-5.7775	168.4442
	residues	-149.7633*	28.39082	.005	-236.8742	-62.6525

Based on observed means.

The error term is Mean Square(Error) = 1209.058.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.673[a]	2	.837	1091.188	.000
Intercept	2.603	1	2.603	3395.014	.000
SampleType	1.673	2	.837	1091.188	.000
Error	.005	6	.001		
Total	4.281	9			
Corrected Total	1.678	8			

a. R Squared = .997 (Adjusted R Squared = .996)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-1.0533*	.02261	.000	-1.1227	-.9840
	substrate	-.4600*	.02261	.000	-.5294	-.3906
residues	larvae/pupae	1.0533*	.02261	.000	.9840	1.1227
	substrate	.5933*	.02261	.000	.5240	.6627
substrate	larvae/pupae	.4600*	.02261	.000	.3906	.5294
	residues	-.5933*	.02261	.000	-.6627	-.5240

Based on observed means.

The error term is Mean Square(Error) = .001.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Mo

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.171[a]	2	3.585	2.679	.147
Intercept	39.858	1	39.858	29.786	.002
SampleType	7.171	2	3.585	2.679	.147
Error	8.029	6	1.338		
Total	55.058	9			
Corrected Total	15.200	8			

a. R Squared = .472 (Adjusted R Squared = .296)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Mo

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-1.8433	.94452	.205	-4.7414	1.0547
	substrate	-1.9400	.94452	.180	-4.8380	.9580
residues	larvae/pupae	1.8433	.94452	.205	-1.0547	4.7414
	substrate	-.0967	.94452	.994	-2.9947	2.8014
substrate	larvae/pupae	1.9400	.94452	.180	-.9580	4.8380
	residues	.0967	.94452	.994	-2.8014	2.9947

Based on observed means.

The error term is Mean Square(Error) = 1.338.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.118[a]	2	.059	1.859	.235
Intercept	.260	1	.260	8.165	.029
SampleType	.118	2	.059	1.859	.235
Error	.191	6	.032		
Total	.570	9			
Corrected Total	.310	8			

a. R Squared = .383 (Adjusted R Squared = .177)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Cd

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.2167	.14573	.361	-.6638	.2305
	substrate	-.2633	.14573	.246	-.7105	.1838
residues	larvae/pupae	.2167	.14573	.361	-.2305	.6638
	substrate	-.0467	.14573	.946	-.4938	.4005
substrate	larvae/pupae	.2633	.14573	.246	-.1838	.7105
	residues	.0467	.14573	.946	-.4005	.4938

Based on observed means.

The error term is Mean Square(Error) = .032.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	32.489[a]	2	16.245	397.074	.000
Intercept	50.221	1	50.221	1227.560	.000
SampleType	32.489	2	16.245	397.074	.000
Error	.245	6	.041		
Total	82.956	9			
Corrected Total	32.735	8			

a. R Squared = .993 (Adjusted R Squared = .990)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-4.6067*	.16515	.000	-5.1134	-4.0999
	substrate	-1.7300*	.16515	.000	-2.2367	-1.2233
residues	larvae/pupae	4.6067*	.16515	.000	4.0999	5.1134
	substrate	2.8767*	.16515	.000	2.3699	3.3834
substrate	larvae/pupae	1.7300*	.16515	.000	1.2233	2.2367
	residues	-2.8767*	.16515	.000	-3.3834	-2.3699

Based on observed means.

The error term is Mean Square(Error) = .041.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Na

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	21626968.974[a]	2	10813484.487	71.265	.000
Intercept	75459567.651	1	75459567.651	497.307	.000
SampleType	21626968.974	2	10813484.487	71.265	.000
Error	910418.972	6	151736.495		
Total	97996955.597	9			
Corrected Total	22537387.947	8			

a. R Squared = .960 (Adjusted R Squared = .946)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Na

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-3794.5733*	318.05293	.000	-4770.4470	-2818.6996
	substrate	-2017.2633*	318.05293	.002	-2993.1370	-1041.3896
residues	larvae/pupae	3794.5733*	318.05293	.000	2818.6996	4770.4470
	substrate	1777.3100*	318.05293	.003	801.4363	2753.1837
substrate	larvae/pupae	2017.2633*	318.05293	.002	1041.3896	2993.1370
	residues	-1777.3100*	318.05293	.003	-2753.1837	-801.4363

Based on observed means.

The error term is Mean Square(Error) = 151736.495.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Mg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	27022019.936[a]	2	13511009.968	26.834	.001
Intercept	275857995.187	1	275857995.187	547.874	.000
SampleType	27022019.936	2	13511009.968	26.834	.001
Error	3021038.429	6	503506.405		
Total	305901053.552	9			
Corrected Total	30043058.365	8			

a. R Squared = .899 (Adjusted R Squared = .866)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Mg

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-4019.0767*	579.37116	.001	-5796.7465	-2241.4069
	substrate	-827.8967	579.37116	.386	-2605.5665	949.7731
residues	larvae/pupae	4019.0767*	579.37116	.001	2241.4069	5796.7465
	substrate	3191.1800*	579.37116	.004	1413.5102	4968.8498
substrate	larvae/pupae	827.8967	579.37116	.386	-949.7731	2605.5665
	residues	-3191.1800*	579.37116	.004	-4968.8498	-1413.5102

Based on observed means.

The error term is Mean Square(Error) = 503506.405.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	78139693.345[a]	2	39069846.673	93.980	.000
Intercept	150450013.184	1	150450013.184	361.898	.000
SampleType	78139693.345	2	39069846.673	93.980	.000
Error	2494348.572	6	415724.762		
Total	231084055.101	9			
Corrected Total	80634041.917	8			

a. R Squared = .969 (Adjusted R Squared = .959)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-7120.6000*	526.45023	.000	-8735.8939	-5505.3061
	substrate	-4581.3967*	526.45023	.000	-6196.6905	-2966.1028
residues	larvae/pupae	7120.6000*	526.45023	.000	5505.3061	8735.8939
	substrate	2539.2033*	526.45023	.007	923.9095	4154.4972
substrate	larvae/pupae	4581.3967*	526.45023	.000	2966.1028	6196.6905
	residues	-2539.2033*	526.45023	.007	-4154.4972	-923.9095

Based on observed means.

The error term is Mean Square(Error) = 415724.762.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Si

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	81891.007[a]	2	40945.504	12.958	.007
Intercept	331280.825	1	331280.825	104.841	.000
SampleType	81891.007	2	40945.504	12.958	.007
Error	18959.062	6	3159.844		
Total	432130.895	9			
Corrected Total	100850.070	8			

a. R Squared = .812 (Adjusted R Squared = .749)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Si

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-161.9600*	45.89730	.029	-302.7855	-21.1345
	substrate	64.8700	45.89730	.393	-75.9555	205.6955
residues	larvae/pupae	161.9600*	45.89730	.029	21.1345	302.7855
	substrate	226.8300*	45.89730	.006	86.0045	367.6555
substrate	larvae/pupae	-64.8700	45.89730	.393	-205.6955	75.9555
	residues	-226.8300*	45.89730	.006	-367.6555	-86.0045

Based on observed means.

The error term is Mean Square(Error) = 3159.844.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - S

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	52788550.352[a]	2	26394275.176	46.318	.000
Intercept	287386578.150	1	287386578.150	504.326	.000
SampleType	52788550.352	2	26394275.176	46.318	.000
Error	3419060.042	6	569843.340		
Total	343594188.545	9			
Corrected Total	56207610.394	8			

a. R Squared = .939 (Adjusted R Squared = .919)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - S

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-5925.5167*	616.35668	.000	-7816.6682	-4034.3651
	substrate	-3208.6533*	616.35668	.005	-5099.8049	-1317.5018
residues	larvae/pupae	5925.5167*	616.35668	.000	4034.3651	7816.6682
	substrate	2716.8633*	616.35668	.011	825.7118	4608.0149
substrate	larvae/pupae	3208.6533*	616.35668	.005	1317.5018	5099.8049
	residues	-2716.8633*	616.35668	.011	-4608.0149	-825.7118

Based on observed means.

The error term is Mean Square(Error) = 569843.340.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - K

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	31774941.001[a]	2	15887470.500	6.224	.034
Intercept	955319299.898	1	955319299.898	374.257	.000
SampleType	31774941.001	2	15887470.500	6.224	.034
Error	15315457.820	6	2552576.303		
Total	1002409698.719	9			
Corrected Total	47090398.821	8			

a. R Squared = .675 (Adjusted R Squared = .566)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - K

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-1858.3400	1304.49896	.388	-5860.9010	2144.2210
	substrate	2717.3900	1304.49896	.174	-1285.1710	6719.9510
residues	larvae/pupae	1858.3400	1304.49896	.388	-2144.2210	5860.9010
	substrate	4575.7300*	1304.49896	.029	573.1690	8578.2910
substrate	larvae/pupae	-2717.3900	1304.49896	.174	-6719.9510	1285.1710
	residues	-4575.7300*	1304.49896	.029	-8578.2910	-573.1690

Based on observed means.

The error term is Mean Square(Error) = 2552576.303.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Ca

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3628903147.025[a]	2	1814451573.513	32.835	.001
Intercept	3297546019.376	1	3297546019.376	59.674	.000
SampleType	3628903147.025	2	1814451573.513	32.835	.001
Error	331557136.054	6	55259522.676		
Total	7258006302.456	9			
Corrected Total	3960460283.079	8			

a. R Squared = .916 (Adjusted R Squared = .888)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Ca

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	44198.9933*	6069.57015	.001	25575.8854	62822.1013
	substrate	40788.7533*	6069.57015	.001	22165.6454	59411.8613
residues	larvae/pupae	-44198.9933*	6069.57015	.001	-62822.1013	-25575.8854
	substrate	-3410.2400	6069.57015	.844	-22033.3480	15212.8680
substrate	larvae/pupae	-40788.7533*	6069.57015	.001	-59411.8613	-22165.6454
	residues	3410.2400	6069.57015	.844	-15212.8680	22033.3480

Based on observed means.

The error term is Mean Square(Error) = 55259522.676.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	340.422[a]	2	170.211	132.341	.000
Intercept	673.057	1	673.057	523.309	.000
SampleType	340.422	2	170.211	132.341	.000
Error	7.717	6	1.286		
Total	1021.196	9			
Corrected Total	348.139	8			

a. R Squared = .978 (Adjusted R Squared = .970)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Cr

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-14.7700*	.92598	.000	-17.6112	-11.9288
	substrate	-9.9533*	.92598	.000	-12.7945	-7.1122
residues	larvae/pupae	14.7700*	.92598	.000	11.9288	17.6112
	substrate	4.8167*	.92598	.005	1.9755	7.6578
substrate	larvae/pupae	9.9533*	.92598	.000	7.1122	12.7945
	residues	-4.8167*	.92598	.005	-7.6578	-1.9755

Based on observed means.

The error term is Mean Square(Error) = 1.286.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	172056.573[a]	2	86028.286	22.647	.002
Intercept	418238.136	1	418238.136	110.100	.000
SampleType	172056.573	2	86028.286	22.647	.002
Error	22792.215	6	3798.702		
Total	613086.923	9			
Corrected Total	194848.788	8			

a. R Squared = .883 (Adjusted R Squared = .844)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	275.7100*	50.32364	.004	121.3033	430.1167
	substrate	308.1967*	50.32364	.002	153.7899	462.6034
residues	larvae/pupae	-275.7100*	50.32364	.004	-430.1167	-121.3033
	substrate	32.4867	50.32364	.802	-121.9201	186.8934
substrate	larvae/pupae	-308.1967*	50.32364	.002	-462.6034	-153.7899
	residues	-32.4867	50.32364	.802	-186.8934	121.9201

Based on observed means.

The error term is Mean Square(Error) = 3798.702.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	53200381.624[a]	2	26600190.812	95.526	.000
Intercept	111268320.624	1	111268320.624	399.582	.000
SampleType	53200381.624	2	26600190.812	95.526	.000
Error	1670768.948	6	278461.491		
Total	166139471.197	9			
Corrected Total	54871150.572	8			

a. R Squared = .970 (Adjusted R Squared = .959)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-5881.9367*	430.86076	.000	-7203.9358	-4559.9375
	substrate	-3748.6233*	430.86076	.000	-5070.6225	-2426.6242
residues	larvae/pupae	5881.9367*	430.86076	.000	4559.9375	7203.9358
	substrate	2133.3133*	430.86076	.006	811.3142	3455.3125
substrate	larvae/pupae	3748.6233*	430.86076	.000	2426.6242	5070.6225
	residues	-2133.3133*	430.86076	.006	-3455.3125	-811.3142

Based on observed means.

The error term is Mean Square(Error) = 278461.491.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4.686[a]	2	2.343	112.465	.000
Intercept	9.080	1	9.080	435.849	.000
SampleType	4.686	2	2.343	112.465	.000
Error	.125	6	.021		
Total	13.891	9			
Corrected Total	4.811	8			

a. R Squared = .974 (Adjusted R Squared = .965)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-1.7533*	.11785	.000	-2.1149	-1.3917
	substrate	-1.0700*	.11785	.000	-1.4316	-.7084
residues	larvae/pupae	1.7533*	.11785	.000	1.3917	2.1149
	substrate	.6833*	.11785	.003	.3217	1.0449
substrate	larvae/pupae	1.0700*	.11785	.000	.7084	1.4316
	residues	-.6833*	.11785	.003	-1.0449	-.3217

Based on observed means.

The error term is Mean Square(Error) = .021.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	135.623[a]	2	67.811	209.733	.000
Intercept	247.958	1	247.958	766.905	.000
SampleType	135.623	2	67.811	209.733	.000
Error	1.940	6	.323		
Total	385.520	9			
Corrected Total	137.563	8			

a. R Squared = .986 (Adjusted R Squared = .981)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-9.4367*	.46427	.000	-10.8612	-8.0122
	substrate	-5.7300*	.46427	.000	-7.1545	-4.3055
residues	larvae/pupae	9.4367*	.46427	.000	8.0122	10.8612
	substrate	3.7067*	.46427	.001	2.2822	5.1312
substrate	larvae/pupae	5.7300*	.46427	.000	4.3055	7.1545
	residues	-3.7067*	.46427	.001	-5.1312	-2.2822

Based on observed means.

The error term is Mean Square(Error) = .323.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	171994.292[a]	2	85997.146	80.559	.000
Intercept	363444.199	1	363444.199	340.463	.000
SampleType	171994.292	2	85997.146	80.559	.000
Error	6405.002	6	1067.500		
Total	541843.493	9			
Corrected Total	178399.294	8			

a. R Squared = .964 (Adjusted R Squared = .952)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-330.7967*	26.67709	.000	-412.6493	-248.9440
	substrate	-228.0667*	26.67709	.000	-309.9193	-146.2140
residues	larvae/pupae	330.7967*	26.67709	.000	248.9440	412.6493
	substrate	102.7300*	26.67709	.020	20.8774	184.5826
substrate	larvae/pupae	228.0667*	26.67709	.000	146.2140	309.9193
	residues	-102.7300*	26.67709	.020	-184.5826	-20.8774

Based on observed means.

The error term is Mean Square(Error) = 1067.500.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	149132.282[a]	2	74566.141	6.542	.031
Intercept	1077796.949	1	1077796.949	94.566	.000
SampleType	149132.282	2	74566.141	6.542	.031
Error	68384.092	6	11397.349		
Total	1295313.323	9			
Corrected Total	217516.374	8			

a. R Squared = .686 (Adjusted R Squared = .581)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-314.1633*	87.16784	.026	-581.6182	-46.7085
	substrate	-180.3667	87.16784	.177	-447.8215	87.0882
residues	larvae/pupae	314.1633*	87.16784	.026	46.7085	581.6182
	substrate	133.7967	87.16784	.341	-133.6582	401.2515
substrate	larvae/pupae	180.3667	87.16784	.177	-87.0882	447.8215
	residues	-133.7967	87.16784	.341	-401.2515	133.6582

Based on observed means.

The error term is Mean Square(Error) = 11397.349.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11.982[a]	2	5.991	90.334	.000
Intercept	23.782	1	23.782	358.581	.000
SampleType	11.982	2	5.991	90.334	.000
Error	.398	6	.066		
Total	36.162	9			
Corrected Total	12.380	8			

a. R Squared = .968 (Adjusted R Squared = .957)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-2.8033*	.21027	.000	-3.4485	-2.1582
	substrate	-1.7133*	.21027	.000	-2.3585	-1.0682
residues	larvae/pupae	2.8033*	.21027	.000	2.1582	3.4485
	substrate	1.0900*	.21027	.005	.4448	1.7352
substrate	larvae/pupae	1.7133*	.21027	.000	1.0682	2.3585
	residues	-1.0900*	.21027	.005	-1.7352	-.4448

Based on observed means.

The error term is Mean Square(Error) = .066.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Mo

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17.764[a]	2	8.882	15.452	.004
Intercept	78.382	1	78.382	136.360	.000
SampleType	17.764	2	8.882	15.452	.004
Error	3.449	6	.575		
Total	99.594	9			
Corrected Total	21.212	8			

a. R Squared = .837 (Adjusted R Squared = .783)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Mo

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-3.3967*	.61904	.004	-5.2960	-1.4973
	substrate	-2.1767*	.61904	.029	-4.0760	-.2773
residues	larvae/pupae	3.3967*	.61904	.004	1.4973	5.2960
	substrate	1.2200	.61904	.200	-.6794	3.1194
substrate	larvae/pupae	2.1767*	.61904	.029	.2773	4.0760
	residues	-1.2200	.61904	.200	-3.1194	.6794

Based on observed means.

The error term is Mean Square(Error) = .575.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.031[a]	2	.015	.164	.852
Intercept	2.571	1	2.571	27.238	.002
SampleType	.031	2	.015	.164	.852
Error	.566	6	.094		
Total	3.168	9			
Corrected Total	.597	8			

a. R Squared = .052 (Adjusted R Squared = -.264)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Cd

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0800	.25084	.946	-.8496	.6896
	substrate	-.1433	.25084	.840	-.9130	.6263
residues	larvae/pupae	.0800	.25084	.946	-.6896	.8496
	substrate	-.0633	.25084	.966	-.8330	.7063
substrate	larvae/pupae	.1433	.25084	.840	-.6263	.9130
	residues	.0633	.25084	.966	-.7063	.8330

Based on observed means.

The error term is Mean Square(Error) = .094.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	716.590[a]	2	358.295	178.435	.000
Intercept	1639.440	1	1639.440	816.459	.000
SampleType	716.590	2	358.295	178.435	.000
Error	12.048	6	2.008		
Total	2368.078	9			
Corrected Total	728.638	8			

a. R Squared = .983 (Adjusted R Squared = .978)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-21.7967*	1.15700	.000	-25.3467	-18.2467
	substrate	-12.3033*	1.15700	.000	-15.8533	-8.7533
residues	larvae/pupae	21.7967*	1.15700	.000	18.2467	25.3467
	substrate	9.4933*	1.15700	.000	5.9433	13.0433
substrate	larvae/pupae	12.3033*	1.15700	.000	8.7533	15.8533
	residues	-9.4933*	1.15700	.000	-13.0433	-5.9433

Based on observed means.

The error term is Mean Square(Error) = 2.008.

*. The mean difference is significant at the .05 level.

Appendix C – $Ca(NO_3)_2$-extractable element statistical analyses

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.025[a]	2	.013	.960	.435
Intercept	.074	1	.074	5.629	.055
SampleType	.025	2	.013	.960	.435
Error	.079	6	.013		
Total	.179	9			
Corrected Total	.104	8			

a. R Squared = .242 (Adjusted R Squared = -.010)

Multiple Comparisons

Dependent Variable: Wheat Bran - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.1286	.09376	.412	-.4163	.1591
	substrate	-.0482	.09376	.868	-.3358	.2395
residues	larvae/pupae	.1286	.09376	.412	-.1591	.4163
	substrate	.0804	.09376	.684	-.2072	.3681
substrate	larvae/pupae	.0482	.09376	.868	-.2395	.3358
	residues	-.0804	.09376	.684	-.3681	.2072

Based on observed means.

The error term is Mean Square(Error) = .013.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.000[a]	2	.000	.	.
Intercept	.001	1	.001	.	.
SampleType	.000	2	.000	.	.
Error	.000	6	.000		
Total	.001	9			
Corrected Total	.000	8			

a. R Squared = . (Adjusted R Squared = .)

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	498.693[a]	2	249.346	25.576	.001
Intercept	562.553	1	562.553	57.703	.000
SampleType	498.693	2	249.346	25.576	.001
Error	58.495	6	9.749		
Total	1119.741	9			
Corrected Total	557.188	8			

a. R Squared = .895 (Adjusted R Squared = .860)

Multiple Comparisons

Dependent Variable: Wheat Bran - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	15.5943*	2.54940	.002	7.7720	23.4165
	substrate	15.9801*	2.54940	.002	8.1578	23.8023
residues	larvae/pupae	-15.5943*	2.54940	.002	-23.4165	-7.7720
	substrate	.3858	2.54940	.987	-7.4365	8.2080
substrate	larvae/pupae	-15.9801*	2.54940	.002	-23.8023	-8.1578
	residues	-.3858	2.54940	.987	-8.2080	7.4365

Based on observed means.

The error term is Mean Square(Error) = 9.749.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5.590[a]	2	2.795	19.714	.002
Intercept	12.733	1	12.733	89.813	.000
SampleType	5.590	2	2.795	19.714	.002
Error	.851	6	.142		
Total	19.173	9			
Corrected Total	6.440	8			

a. R Squared = .868 (Adjusted R Squared = .824)

Multiple Comparisons

Dependent Variable: Wheat Bran - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-1.8486*	.30743	.002	-2.7919	-.9054
	substrate	-.4429	.30743	.381	-1.3862	.5003
residues	larvae/pupae	1.8486*	.30743	.002	.9054	2.7919
	substrate	1.4057*	.30743	.009	.4624	2.3490
substrate	larvae/pupae	.4429	.30743	.381	-.5003	1.3862
	residues	-1.4057*	.30743	.009	-2.3490	-.4624

Based on observed means.

The error term is Mean Square(Error) = .142.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.001[a]	2	.000	72.154	.000
Intercept	.003	1	.003	493.708	.000
SampleType	.001	2	.000	72.154	.000
Error	4.014E-5	6	6.689E-6		
Total	.004	9			
Corrected Total	.001	8			

a. R Squared = .960 (Adjusted R Squared = .947)

Multiple Comparisons

Dependent Variable: Wheat Bran - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0244*	.00211	.000	-.0309	-.0179
	substrate	-.0061	.00211	.063	-.0126	.0004
residues	larvae/pupae	.0244*	.00211	.000	.0179	.0309
	substrate	.0183*	.00211	.000	.0118	.0248
substrate	larvae/pupae	.0061	.00211	.063	-.0004	.0126
	residues	-.0183*	.00211	.000	-.0248	-.0118

Based on observed means.

The error term is Mean Square(Error) = 6.69E-006.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.112[a]	2	.056	93.801	.000
Intercept	.152	1	.152	254.010	.000
SampleType	.112	2	.056	93.801	.000
Error	.004	6	.001		
Total	.268	9			
Corrected Total	.116	8			

a. R Squared = .969 (Adjusted R Squared = .959)

Multiple Comparisons

Dependent Variable: Wheat Bran - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0903*	.01998	.010	-.1515	-.0290
	substrate	-.2688*	.01998	.000	-.3301	-.2075
residues	larvae/pupae	.0903*	.01998	.010	.0290	.1515
	substrate	-.1786*	.01998	.000	-.2399	-.1173
substrate	larvae/pupae	.2688*	.01998	.000	.2075	.3301
	residues	.1786*	.01998	.000	.1173	.2399

Based on observed means.

The error term is Mean Square(Error) = .001.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.171[a]	2	.086	4.885	.055
Intercept	1.698	1	1.698	96.872	.000
SampleType	.171	2	.086	4.885	.055
Error	.105	6	.018		
Total	1.974	9			
Corrected Total	.276	8			

a. R Squared = .620 (Adjusted R Squared = .493)

Multiple Comparisons

Dependent Variable: Wheat Bran - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.3319*	.10809	.050	-.6635	-.0002
	substrate	-.1113	.10809	.587	-.4429	.2203
residues	larvae/pupae	.3319*	.10809	.050	.0002	.6635
	substrate	.2206	.10809	.183	-.1111	.5522
substrate	larvae/pupae	.1113	.10809	.587	-.2203	.4429
	residues	-.2206	.10809	.183	-.5522	.1111

Based on observed means.

The error term is Mean Square(Error) = .018.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.705[a]	2	.853	1.749	.252
Intercept	6.745	1	6.745	13.838	.010
SampleType	1.705	2	.853	1.749	.252
Error	2.925	6	.487		
Total	11.375	9			
Corrected Total	4.630	8			

a. R Squared = .368 (Adjusted R Squared = .158)

Multiple Comparisons

Dependent Variable: Wheat Bran - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.9108	.57006	.317	-.8383	2.6599
	substrate	.9354	.57006	.301	-.8137	2.6845
residues	larvae/pupae	-.9108	.57006	.317	-2.6599	.8383
	substrate	.0246	.57006	.999	-1.7245	1.7737
substrate	larvae/pupae	-.9354	.57006	.301	-2.6845	.8137
	residues	-.0246	.57006	.999	-1.7737	1.7245

Based on observed means.

The error term is Mean Square(Error) = .487.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.001[a]	2	.000	66.835	.000
Intercept	.003	1	.003	565.164	.000
SampleType	.001	2	.000	66.835	.000
Error	2.893E-5	6	4.821E-6		
Total	.003	9			
Corrected Total	.001	8			

a. R Squared = .957 (Adjusted R Squared = .943)

Multiple Comparisons

Dependent Variable: Wheat Bran - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0200*	.00179	.000	-.0255	-.0145
	substrate	-.0052	.00179	.061	-.0107	.0003
residues	larvae/pupae	.0200*	.00179	.000	.0145	.0255
	substrate	.0148*	.00179	.000	.0093	.0203
substrate	larvae/pupae	.0052	.00179	.061	-.0003	.0107
	residues	-.0148*	.00179	.000	-.0203	-.0093

Based on observed means.

The error term is Mean Square(Error) = 4.82E-006.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.000[a]	2	.000	.	.
Intercept	.001	1	.001	.	.
SampleType	.000	2	.000	.	.
Error	.000	6	.000		
Total	.001	9			
Corrected Total	.000	8			

a. R Squared = . (Adjusted R Squared = .)

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.240E-6[a]	2	3.620E-6	1.000	.422
Intercept	.001	1	.001	230.757	.000
SampleType	7.240E-6	2	3.620E-6	1.000	.422
Error	2.172E-5	6	3.620E-6		
Total	.001	9			
Corrected Total	2.896E-5	8			

a. R Squared = .250 (Adjusted R Squared = .000)

Multiple Comparisons

Dependent Variable: Wheat Bran - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	.0000	.00155	1.000	-.0048	.0048
	substrate	-.0019	.00155	.483	-.0067	.0029
residues	larvae/pupae	.0000	.00155	1.000	-.0048	.0048
	substrate	-.0019	.00155	.483	-.0067	.0029
substrate	larvae/pupae	.0019	.00155	.483	-.0029	.0067
	residues	.0019	.00155	.483	-.0029	.0067

Based on observed means.

The error term is Mean Square(Error) = 3.62E-006.

Tests of Between-Subjects Effects

Dependent Variable: Food - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.077[a]	2	.038	21.823	.002
Intercept	.212	1	.212	121.067	.000
SampleType	.077	2	.038	21.823	.002
Error	.011	6	.002		
Total	.300	9			
Corrected Total	.087	8			

a. R Squared = .879 (Adjusted R Squared = .839)

Multiple Comparisons

Dependent Variable: Food - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.1337*	.03420	.019	-.2387	-.0288
	substrate	-.2246*	.03420	.001	-.3295	-.1197
residues	larvae/pupae	.1337*	.03420	.019	.0288	.2387
	substrate	-.0909	.03420	.084	-.1958	.0141
substrate	larvae/pupae	.2246*	.03420	.001	.1197	.3295
	residues	.0909	.03420	.084	-.0141	.1958

Based on observed means.

The error term is Mean Square(Error) = .002.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	179.304[a]	2	89.652	439.325	.000
Intercept	123.415	1	123.415	604.776	.000
SampleType	179.304	2	89.652	439.325	.000
Error	1.224	6	.204		
Total	303.944	9			
Corrected Total	180.529	8			

a. R Squared = .993 (Adjusted R Squared = .991)

Multiple Comparisons

Dependent Variable: Food - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.8158	.36884	.147	-.3159	1.9475
	substrate	-9.0342*	.36884	.000	-10.1659	-7.9025
residues	larvae/pupae	-.8158	.36884	.147	-1.9475	.3159
	substrate	-9.8500*	.36884	.000	-10.9817	-8.7183
substrate	larvae/pupae	9.0342*	.36884	.000	7.9025	10.1659
	residues	9.8500*	.36884	.000	8.7183	10.9817

Based on observed means.

The error term is Mean Square(Error) = .204.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.176[a]	2	.088	13.420	.006
Intercept	.824	1	.824	125.927	.000
SampleType	.176	2	.088	13.420	.006
Error	.039	6	.007		
Total	1.039	9			
Corrected Total	.215	8			

a. R Squared = .817 (Adjusted R Squared = .756)

Multiple Comparisons

Dependent Variable: Food - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	.3380*	.06605	.005	.1353	.5407
	substrate	.1227	.06605	.231	-.0799	.3254
residues	larvae/pupae	-.3380*	.06605	.005	-.5407	-.1353
	substrate	-.2153*	.06605	.040	-.4179	-.0126
substrate	larvae/pupae	-.1227	.06605	.231	-.3254	.0799
	residues	.2153*	.06605	.040	.0126	.4179

Based on observed means.

The error term is Mean Square(Error) = .007.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.284[a]	2	.142	65.217	.000
Intercept	.738	1	.738	338.902	.000
SampleType	.284	2	.142	65.217	.000
Error	.013	6	.002		
Total	1.035	9			
Corrected Total	.297	8			

a. R Squared = .956 (Adjusted R Squared = .941)

Multiple Comparisons

Dependent Variable: Food - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.3236*	.03810	.000	-.4405	-.2068
	substrate	-.4137*	.03810	.000	-.5306	-.2968
residues	larvae/pupae	.3236*	.03810	.000	.2068	.4405
	substrate	-.0900	.03810	.122	-.2069	.0269
substrate	larvae/pupae	.4137*	.03810	.000	.2968	.5306
	residues	.0900	.03810	.122	-.0269	.2069

Based on observed means.

The error term is Mean Square(Error) = .002.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.140[a]	2	.070	23.869	.001
Intercept	.637	1	.637	217.100	.000
SampleType	.140	2	.070	23.869	.001
Error	.018	6	.003		
Total	.795	9			
Corrected Total	.158	8			

a. R Squared = .888 (Adjusted R Squared = .851)

Multiple Comparisons

Dependent Variable: Food - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.2961*	.04424	.001	.1604	.4319
	substrate	.0826	.04424	.228	-.0531	.2183
residues	larvae/pupae	-.2961*	.04424	.001	-.4319	-.1604
	substrate	-.2135*	.04424	.007	-.3493	-.0778
substrate	larvae/pupae	-.0826	.04424	.228	-.2183	.0531
	residues	.2135*	.04424	.007	.0778	.3493

Based on observed means.

The error term is Mean Square(Error) = .003.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6.748[a]	2	3.374	24.475	.001
Intercept	15.719	1	15.719	114.023	.000
SampleType	6.748	2	3.374	24.475	.001
Error	.827	6	.138		
Total	23.295	9			
Corrected Total	7.576	8			

a. R Squared = .891 (Adjusted R Squared = .854)

Multiple Comparisons

Dependent Variable: Food - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	1.5182*	.30316	.006	.5880	2.4483
	substrate	-.5237	.30316	.271	-1.4539	.4064
residues	larvae/pupae	-1.5182*	.30316	.006	-2.4483	-.5880
	substrate	-2.0419*	.30316	.001	-2.9721	-1.1117
substrate	larvae/pupae	.5237	.30316	.271	-.4064	1.4539
	residues	2.0419*	.30316	.001	1.1117	2.9721

Based on observed means.

The error term is Mean Square(Error) = .138.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.002[a]	2	.001	1.000	.422
Intercept	.003	1	.003	3.676	.104
SampleType	.002	2	.001	1.000	.422
Error	.005	6	.001		
Total	.010	9			
Corrected Total	.007	8			

a. R Squared = .250 (Adjusted R Squared = .000)

Multiple Comparisons

Dependent Variable: Food - Cd

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	.0000	.02403	1.000	-.0737	.0737
	substrate	-.0294	.02403	.483	-.1032	.0443
residues	larvae/pupae	.0000	.02403	1.000	-.0737	.0737
	substrate	-.0294	.02403	.483	-.1032	.0443
substrate	larvae/pupae	.0294	.02403	.483	-.0443	.1032
	residues	.0294	.02403	.483	-.0443	.1032

Based on observed means.

The error term is Mean Square(Error) = .001.

Tests of Between-Subjects Effects

Dependent Variable: Food - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5.230E-6[a]	2	2.615E-6	3.966	.080
Intercept	.001	1	.001	1241.955	.000
SampleType	5.230E-6	2	2.615E-6	3.966	.080
Error	3.956E-6	6	6.594E-7		
Total	.001	9			
Corrected Total	9.186E-6	8			

a. R Squared = .569 (Adjusted R Squared = .426)

Multiple Comparisons

Dependent Variable: Food - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	.0000	.00066	1.000	-.0020	.0020
	substrate	-.0016	.00066	.110	-.0037	.0004
residues	larvae/pupae	.0000	.00066	1.000	-.0020	.0020
	substrate	-.0016	.00066	.110	-.0037	.0004
substrate	larvae/pupae	.0016	.00066	.110	-.0004	.0037
	residues	.0016	.00066	.110	-.0004	.0037

Based on observed means.

The error term is Mean Square(Error) = 6.59E-007.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	54.397[a]	2	27.198	15.530	.004
Intercept	60.360	1	60.360	34.464	.001
SampleType	54.397	2	27.198	15.530	.004
Error	10.508	6	1.751		
Total	125.265	9			
Corrected Total	64.905	8			

a. R Squared = .838 (Adjusted R Squared = .784)

Multiple Comparisons

Dependent Variable: Biosolids1 - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0460	1.08055	.999	-3.3614	3.2694
	substrate	-5.2381*	1.08055	.007	-8.5535	-1.9226
residues	larvae/pupae	.0460	1.08055	.999	-3.2694	3.3614
	substrate	-5.1920*	1.08055	.007	-8.5075	-1.8766
substrate	larvae/pupae	5.2381*	1.08055	.007	1.9226	8.5535
	residues	5.1920*	1.08055	.007	1.8766	8.5075

Based on observed means.

The error term is Mean Square(Error) = 1.751.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.025[a]	2	.013	133.585	.000
Intercept	.022	1	.022	239.184	.000
SampleType	.025	2	.013	133.585	.000
Error	.001	6	9.402E-5		
Total	.048	9			
Corrected Total	.026	8			

a. R Squared = .978 (Adjusted R Squared = .971)

Multiple Comparisons

Dependent Variable: Biosolids1 - Cr

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0074	.00792	.642	-.0317	.0169
	substrate	-.1156*	.00792	.000	-.1399	-.0913
residues	larvae/pupae	.0074	.00792	.642	-.0169	.0317
	substrate	-.1082*	.00792	.000	-.1325	-.0839
substrate	larvae/pupae	.1156*	.00792	.000	.0913	.1399
	residues	.1082*	.00792	.000	.0839	.1325

Based on observed means.

The error term is Mean Square(Error) = 9.40E-005.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.339[a]	2	1.170	5.980	.037
Intercept	20.646	1	20.646	105.545	.000
SampleType	2.339	2	1.170	5.980	.037
Error	1.174	6	.196		
Total	24.159	9			
Corrected Total	3.513	8			

a. R Squared = .666 (Adjusted R Squared = .555)

Multiple Comparisons

Dependent Variable: Biosolids1 - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.5407	.36112	.357	-.5673	1.6487
	substrate	-.7045	.36112	.205	-1.8126	.4035
residues	larvae/pupae	-.5407	.36112	.357	-1.6487	.5673
	substrate	-1.2452*	.36112	.032	-2.3533	-.1372
substrate	larvae/pupae	.7045	.36112	.205	-.4035	1.8126
	residues	1.2452*	.36112	.032	.1372	2.3533

Based on observed means.

The error term is Mean Square(Error) = .196.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	931.789[a]	2	465.894	42.843	.000
Intercept	856.247	1	856.247	78.740	.000
SampleType	931.789	2	465.894	42.843	.000
Error	65.247	6	10.874		
Total	1853.283	9			
Corrected Total	997.035	8			

a. R Squared = .935 (Adjusted R Squared = .913)

Multiple Comparisons

Dependent Variable: Biosolids1 - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	.2278	2.69251	.996	-8.0336	8.4892
	substrate	-21.4698*	2.69251	.001	-29.7311	-13.2084
residues	larvae/pupae	-.2278	2.69251	.996	-8.4892	8.0336
	substrate	-21.6976*	2.69251	.000	-29.9590	-13.4362
substrate	larvae/pupae	21.4698*	2.69251	.001	13.2084	29.7311
	residues	21.6976*	2.69251	.000	13.4362	29.9590

Based on observed means.

The error term is Mean Square(Error) = 10.874.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.021[a]	2	.010	69.621	.000
Intercept	.034	1	.034	229.903	.000
SampleType	.021	2	.010	69.621	.000
Error	.001	6	.000		
Total	.056	9			
Corrected Total	.022	8			

a. R Squared = .959 (Adjusted R Squared = .945)

Multiple Comparisons

Dependent Variable: Biosolids1 - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0420*	.00997	.013	-.0726	-.0114
	substrate	-.1162*	.00997	.000	-.1468	-.0856
residues	larvae/pupae	.0420*	.00997	.013	.0114	.0726
	substrate	-.0742*	.00997	.001	-.1048	-.0436
substrate	larvae/pupae	.1162*	.00997	.000	.0856	.1468
	residues	.0742*	.00997	.001	.0436	.1048

Based on observed means.

The error term is Mean Square(Error) = .000.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.347[a]	2	.674	120.252	.000
Intercept	.957	1	.957	170.786	.000
SampleType	1.347	2	.674	120.252	.000
Error	.034	6	.006		
Total	2.338	9			
Corrected Total	1.381	8			

a. R Squared = .976 (Adjusted R Squared = .968)

Multiple Comparisons

Dependent Variable: Biosolids1 - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0698	.06111	.526	-.2573	.1178
	substrate	-.8534*	.06111	.000	-1.0410	-.6659
residues	larvae/pupae	.0698	.06111	.526	-.1178	.2573
	substrate	-.7837*	.06111	.000	-.9712	-.5962
substrate	larvae/pupae	.8534*	.06111	.000	.6659	1.0410
	residues	.7837*	.06111	.000	.5962	.9712

Based on observed means.

The error term is Mean Square(Error) = .006.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	340.783[a]	2	170.392	239.186	.000
Intercept	278.346	1	278.346	390.726	.000
SampleType	340.783	2	170.392	239.186	.000
Error	4.274	6	.712		
Total	623.403	9			
Corrected Total	345.057	8			

a. R Squared = .988 (Adjusted R Squared = .983)

Multiple Comparisons

Dependent Variable: Biosolids1 - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.5294	.68915	.735	-2.6439	1.5851
	substrate	-13.3100*	.68915	.000	-15.4245	-11.1956
residues	larvae/pupae	.5294	.68915	.735	-1.5851	2.6439
	substrate	-12.7807*	.68915	.000	-14.8952	-10.6662
substrate	larvae/pupae	13.3100*	.68915	.000	11.1956	15.4245
	residues	12.7807*	.68915	.000	10.6662	14.8952

Based on observed means.

The error term is Mean Square(Error) = .712.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1563.756[a]	2	781.878	130.032	.000
Intercept	1090.037	1	1090.037	181.281	.000
SampleType	1563.756	2	781.878	130.032	.000
Error	36.078	6	6.013		
Total	2689.871	9			
Corrected Total	1599.834	8			

a. R Squared = .977 (Adjusted R Squared = .970)

Multiple Comparisons

Dependent Variable: Biosolids1 - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	1.0919	2.00216	.853	-5.0513	7.2351
	substrate	-27.4001*	2.00216	.000	-33.5433	-21.2570
residues	larvae/pupae	-1.0919	2.00216	.853	-7.2351	5.0513
	substrate	-28.4920*	2.00216	.000	-34.6352	-22.3489
substrate	larvae/pupae	27.4001*	2.00216	.000	21.2570	33.5433
	residues	28.4920*	2.00216	.000	22.3489	34.6352

Based on observed means.

The error term is Mean Square(Error) = 6.013.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.262[a]	2	.131	110.612	.000
Intercept	.721	1	.721	608.015	.000
SampleType	.262	2	.131	110.612	.000
Error	.007	6	.001		
Total	.990	9			
Corrected Total	.269	8			

a. R Squared = .974 (Adjusted R Squared = .965)

Multiple Comparisons

Dependent Variable: Biosolids1 - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.3560*	.02811	.000	-.4422	-.2697
	substrate	-.3679*	.02811	.000	-.4541	-.2816
residues	larvae/pupae	.3560*	.02811	.000	.2697	.4422
	substrate	-.0119	.02811	.907	-.0982	.0743
substrate	larvae/pupae	.3679*	.02811	.000	.2816	.4541
	residues	.0119	.02811	.907	-.0743	.0982

Based on observed means.

The error term is Mean Square(Error) = .001.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.380E-5[a]	2	6.900E-6	1.441	.308
Intercept	.001	1	.001	209.978	.000
SampleType	1.380E-5	2	6.900E-6	1.441	.308
Error	2.873E-5	6	4.788E-6		
Total	.001	9			
Corrected Total	4.253E-5	8			

a. R Squared = .325 (Adjusted R Squared = .099)

Multiple Comparisons

Dependent Variable: Biosolids1 - Cd

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	.0030	.00179	.282	-.0025	.0085
	substrate	.0013	.00179	.742	-.0041	.0068
residues	larvae/pupae	-.0030	.00179	.282	-.0085	.0025
	substrate	-.0017	.00179	.637	-.0072	.0038
substrate	larvae/pupae	-.0013	.00179	.742	-.0068	.0041
	residues	.0017	.00179	.637	-.0038	.0072

Based on observed means.

The error term is Mean Square(Error) = 4.79E-006.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.002[a]	2	.001	9.726	.013
Intercept	.005	1	.005	46.022	.001
SampleType	.002	2	.001	9.726	.013
Error	.001	6	.000		
Total	.008	9			
Corrected Total	.003	8			

a. R Squared = .764 (Adjusted R Squared = .686)

Multiple Comparisons

Dependent Variable: Biosolids1 - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.0032	.00839	.926	-.0226	.0289
	substrate	-.0304*	.00839	.026	-.0561	-.0046
residues	larvae/pupae	-.0032	.00839	.926	-.0289	.0226
	substrate	-.0335*	.00839	.017	-.0593	-.0078
substrate	larvae/pupae	.0304*	.00839	.026	.0046	.0561
	residues	.0335*	.00839	.017	.0078	.0593

Based on observed means.

The error term is Mean Square(Error) = .000.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	676.121[a]	2	338.060	24.781	.001
Intercept	427.780	1	427.780	31.358	.001
SampleType	676.121	2	338.060	24.781	.001
Error	81.850	6	13.642		
Total	1185.751	9			
Corrected Total	757.971	8			

a. R Squared = .892 (Adjusted R Squared = .856)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.6990	3.01570	.971	-9.9520	8.5540
	substrate	-18.7259*	3.01570	.002	-27.9789	-9.4729
residues	larvae/pupae	.6990	3.01570	.971	-8.5540	9.9520
	substrate	-18.0270*	3.01570	.002	-27.2800	-8.7740
substrate	larvae/pupae	18.7259*	3.01570	.002	9.4729	27.9789
	residues	18.0270*	3.01570	.002	8.7740	27.2800

Based on observed means.

The error term is Mean Square(Error) = 13.642.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.115[a]	2	.057	25.405	.001
Intercept	.076	1	.076	33.555	.001
SampleType	.115	2	.057	25.405	.001
Error	.014	6	.002		
Total	.204	9			
Corrected Total	.128	8			

a. R Squared = .894 (Adjusted R Squared = .859)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Cr

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0059	.03877	.988	-.1248	.1131
	substrate	-.2422*	.03877	.002	-.3612	-.1233
residues	larvae/pupae	.0059	.03877	.988	-.1131	.1248
	substrate	-.2364*	.03877	.002	-.3554	-.1174
substrate	larvae/pupae	.2422*	.03877	.002	.1233	.3612
	residues	.2364*	.03877	.002	.1174	.3554

Based on observed means.

The error term is Mean Square(Error) = .002.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	23.021[a]	2	11.510	40.012	.000
Intercept	41.318	1	41.318	143.630	.000
SampleType	23.021	2	11.510	40.012	.000
Error	1.726	6	.288		
Total	66.065	9			
Corrected Total	24.747	8			

a. R Squared = .930 (Adjusted R Squared = .907)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.7309	.43793	.291	-.6127	2.0746
	substrate	-2.9677*	.43793	.001	-4.3113	-1.6240
residues	larvae/pupae	-.7309	.43793	.291	-2.0746	.6127
	substrate	-3.6986*	.43793	.000	-5.0423	-2.3549
substrate	larvae/pupae	2.9677*	.43793	.001	1.6240	4.3113
	residues	3.6986*	.43793	.000	2.3549	5.0423

Based on observed means.

The error term is Mean Square(Error) = .288.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	933.198[a]	2	466.599	22.088	.002
Intercept	682.879	1	682.879	32.327	.001
SampleType	933.198	2	466.599	22.088	.002
Error	126.745	6	21.124		
Total	1742.821	9			
Corrected Total	1059.942	8			

a. R Squared = .880 (Adjusted R Squared = .841)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.5151	3.75270	.990	-12.0294	10.9992
	substrate	-21.8539*	3.75270	.003	-33.3682	-10.3395
residues	larvae/pupae	.5151	3.75270	.990	-10.9992	12.0294
	substrate	-21.3387*	3.75270	.003	-32.8530	-9.8244
substrate	larvae/pupae	21.8539*	3.75270	.003	10.3395	33.3682
	residues	21.3387*	3.75270	.003	9.8244	32.8530

Based on observed means.

The error term is Mean Square(Error) = 21.124.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.011[a]	2	.006	11.233	.009
Intercept	.021	1	.021	41.179	.001
SampleType	.011	2	.006	11.233	.009
Error	.003	6	.001		
Total	.035	9			
Corrected Total	.014	8			

a. R Squared = .789 (Adjusted R Squared = .719)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0315	.01841	.277	-.0879	.0250
	substrate	-.0862*	.01841	.008	-.1427	-.0297
residues	larvae/pupae	.0315	.01841	.277	-.0250	.0879
	substrate	-.0547	.01841	.056	-.1112	.0017
substrate	larvae/pupae	.0862*	.01841	.008	.0297	.1427
	residues	.0547	.01841	.056	-.0017	.1112

Based on observed means.

The error term is Mean Square(Error) = .001.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.216[a]	2	.608	36.050	.000
Intercept	.832	1	.832	49.323	.000
SampleType	1.216	2	.608	36.050	.000
Error	.101	6	.017		
Total	2.149	9			
Corrected Total	1.317	8			

a. R Squared = .923 (Adjusted R Squared = .898)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0698	.10604	.795	-.3952	.2555
	substrate	-.8123*	.10604	.001	-1.1377	-.4870
residues	larvae/pupae	.0698	.10604	.795	-.2555	.3952
	substrate	-.7425*	.10604	.001	-1.0678	-.4171
substrate	larvae/pupae	.8123*	.10604	.001	.4870	1.1377
	residues	.7425*	.10604	.001	.4171	1.0678

Based on observed means.

The error term is Mean Square(Error) = .017.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	60.553[a]	2	30.276	125.492	.000
Intercept	51.339	1	51.339	212.796	.000
SampleType	60.553	2	30.276	125.492	.000
Error	1.448	6	.241		
Total	113.340	9			
Corrected Total	62.000	8			

a. R Squared = .977 (Adjusted R Squared = .969)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.2342	.40105	.833	-1.4648	.9963
	substrate	-5.6158*	.40105	.000	-6.8463	-4.3852
residues	larvae/pupae	.2342	.40105	.833	-.9963	1.4648
	substrate	-5.3815*	.40105	.000	-6.6121	-4.1510
substrate	larvae/pupae	5.6158*	.40105	.000	4.3852	6.8463
	residues	5.3815*	.40105	.000	4.1510	6.6121

Based on observed means.

The error term is Mean Square(Error) = .241.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	767.449[a]	2	383.724	23.335	.001
Intercept	497.209	1	497.209	30.236	.002
SampleType	767.449	2	383.724	23.335	.001
Error	98.666	6	16.444		
Total	1363.324	9			
Corrected Total	866.115	8			

a. R Squared = .886 (Adjusted R Squared = .848)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	.5704	3.31103	.984	-9.5887	10.7296
	substrate	-19.2974*	3.31103	.003	-29.4566	-9.1383
residues	larvae/pupae	-.5704	3.31103	.984	-10.7296	9.5887
	substrate	-19.8679*	3.31103	.002	-30.0270	-9.7087
substrate	larvae/pupae	19.2974*	3.31103	.003	9.1383	29.4566
	residues	19.8679*	3.31103	.002	9.7087	30.0270

Based on observed means.

The error term is Mean Square(Error) = 16.444.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.185[a]	2	.093	36.170	.000
Intercept	.395	1	.395	154.534	.000
SampleType	.185	2	.093	36.170	.000
Error	.015	6	.003		
Total	.596	9			
Corrected Total	.200	8			

a. R Squared = .923 (Adjusted R Squared = .898)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.2624*	.04131	.002	-.3892	-.1357
	substrate	-.3335*	.04131	.000	-.4602	-.2067
residues	larvae/pupae	.2624*	.04131	.002	.1357	.3892
	substrate	-.0711	.04131	.273	-.1978	.0557
substrate	larvae/pupae	.3335*	.04131	.000	.2067	.4602
	residues	.0711	.04131	.273	-.0557	.1978

Based on observed means.

The error term is Mean Square(Error) = .003.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.133E-5[a]	2	5.665E-6	1.000	.422
Intercept	.001	1	.001	152.375	.000
SampleType	1.133E-5	2	5.665E-6	1.000	.422
Error	3.399E-5	6	5.665E-6		
Total	.001	9			
Corrected Total	4.532E-5	8			

a. R Squared = .250 (Adjusted R Squared = .000)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Cd

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.0000	.00194	1.000	-.0060	.0060
	substrate	-.0024	.00194	.483	-.0083	.0036
residues	larvae/pupae	.0000	.00194	1.000	-.0060	.0060
	substrate	-.0024	.00194	.483	-.0083	.0036
substrate	larvae/pupae	.0024	.00194	.483	-.0036	.0083
	residues	.0024	.00194	.483	-.0036	.0083

Based on observed means.

The error term is Mean Square(Error) = 5.66E-006.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.007[a]	2	.004	28.526	.001
Intercept	.008	1	.008	62.114	.000
SampleType	.007	2	.004	28.526	.001
Error	.001	6	.000		
Total	.016	9			
Corrected Total	.008	8			

a. R Squared = .905 (Adjusted R Squared = .873)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0009	.00913	.994	-.0290	.0271
	substrate	-.0602*	.00913	.001	-.0882	-.0322
residues	larvae/pupae	.0009	.00913	.994	-.0271	.0290
	substrate	-.0592*	.00913	.002	-.0873	-.0312
substrate	larvae/pupae	.0602*	.00913	.001	.0322	.0882
	residues	.0592*	.00913	.002	.0312	.0873

Based on observed means.

The error term is Mean Square(Error) = .000.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	725.472[a]	2	362.736	16.259	.004
Intercept	1388.398	1	1388.398	62.232	.000
SampleType	725.472	2	362.736	16.259	.004
Error	133.859	6	22.310		
Total	2247.729	9			
Corrected Total	859.331	8			

a. R Squared = .844 (Adjusted R Squared = .792)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-9.6130	3.85658	.103	-21.4461	2.2200
	substrate	-21.9363*	3.85658	.003	-33.7693	-10.1032
residues	larvae/pupae	9.6130	3.85658	.103	-2.2200	21.4461
	substrate	-12.3232*	3.85658	.043	-24.1563	-.4902
substrate	larvae/pupae	21.9363*	3.85658	.003	10.1032	33.7693
	residues	12.3232*	3.85658	.043	.4902	24.1563

Based on observed means.

The error term is Mean Square(Error) = 22.310.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.003[a]	2	.001	8.953	.016
Intercept	.009	1	.009	54.191	.000
SampleType	.003	2	.001	8.953	.016
Error	.001	6	.000		
Total	.013	9			
Corrected Total	.004	8			

a. R Squared = .749 (Adjusted R Squared = .665)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Cr

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0226	.01037	.153	-.0544	.0092
	substrate	-.0439*	.01037	.013	-.0757	-.0121
residues	larvae/pupae	.0226	.01037	.153	-.0092	.0544
	substrate	-.0213	.01037	.181	-.0531	.0106
substrate	larvae/pupae	.0439*	.01037	.013	.0121	.0757
	residues	.0213	.01037	.181	-.0106	.0531

Based on observed means.

The error term is Mean Square(Error) = .000.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	76.248[a]	2	38.124	16.857	.003
Intercept	394.737	1	394.737	174.536	.000
SampleType	76.248	2	38.124	16.857	.003
Error	13.570	6	2.262		
Total	484.555	9			
Corrected Total	89.818	8			

a. R Squared = .849 (Adjusted R Squared = .799)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	6.9257*	1.22791	.003	3.1581	10.6932
	substrate	1.9963	1.22791	.306	-1.7712	5.7639
residues	larvae/pupae	-6.9257*	1.22791	.003	-10.6932	-3.1581
	substrate	-4.9293*	1.22791	.016	-8.6969	-1.1618
substrate	larvae/pupae	-1.9963	1.22791	.306	-5.7639	1.7712
	residues	4.9293*	1.22791	.016	1.1618	8.6969

Based on observed means.

The error term is Mean Square(Error) = 2.262.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	43.855[a]	2	21.927	17.500	.003
Intercept	111.801	1	111.801	89.227	.000
SampleType	43.855	2	21.927	17.500	.003
Error	7.518	6	1.253		
Total	163.174	9			
Corrected Total	51.373	8			

a. R Squared = .854 (Adjusted R Squared = .805)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-3.5173*	.91397	.020	-6.3215	-.7130
	substrate	-5.3152*	.91397	.003	-8.1195	-2.5109
residues	larvae/pupae	3.5173*	.91397	.020	.7130	6.3215
	substrate	-1.7979	.91397	.201	-4.6022	1.0064
substrate	larvae/pupae	5.3152*	.91397	.003	2.5109	8.1195
	residues	1.7979	.91397	.201	-1.0064	4.6022

Based on observed means.

The error term is Mean Square(Error) = 1.253.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.005[a]	2	.002	246.990	.000
Intercept	.012	1	.012	1304.691	.000
SampleType	.005	2	.002	246.990	.000
Error	5.743E-5	6	9.572E-6		
Total	.017	9			
Corrected Total	.005	8			

a. R Squared = .988 (Adjusted R Squared = .984)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0561*	.00253	.000	-.0639	-.0484
	substrate	-.0286*	.00253	.000	-.0364	-.0209
residues	larvae/pupae	.0561*	.00253	.000	.0484	.0639
	substrate	.0275*	.00253	.000	.0198	.0353
substrate	larvae/pupae	.0286*	.00253	.000	.0209	.0364
	residues	-.0275*	.00253	.000	-.0353	-.0198

Based on observed means.

The error term is Mean Square(Error) = 9.57E-006.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.190[a]	2	.095	17.608	.003
Intercept	.425	1	.425	78.698	.000
SampleType	.190	2	.095	17.608	.003
Error	.032	6	.005		
Total	.647	9			
Corrected Total	.223	8			

a. R Squared = .854 (Adjusted R Squared = .806)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.3168*	.05999	.004	-.5009	-.1328
	substrate	-.2991*	.05999	.006	-.4831	-.1150
residues	larvae/pupae	.3168*	.05999	.004	.1328	.5009
	substrate	.0178	.05999	.953	-.1663	.2019
substrate	larvae/pupae	.2991*	.05999	.006	.1150	.4831
	residues	-.0178	.05999	.953	-.2019	.1663

Based on observed means.

The error term is Mean Square(Error) = .005.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6.941[a]	2	3.470	15.360	.004
Intercept	11.500	1	11.500	50.900	.000
SampleType	6.941	2	3.470	15.360	.004
Error	1.356	6	.226		
Total	19.796	9			
Corrected Total	8.296	8			

a. R Squared = .837 (Adjusted R Squared = .782)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.4859	.38810	.469	-1.6767	.7049
	substrate	-2.0577*	.38810	.004	-3.2485	-.8669
residues	larvae/pupae	.4859	.38810	.469	-.7049	1.6767
	substrate	-1.5718*	.38810	.016	-2.7626	-.3810
substrate	larvae/pupae	2.0577*	.38810	.004	.8669	3.2485
	residues	1.5718*	.38810	.016	.3810	2.7626

Based on observed means.

The error term is Mean Square(Error) = .226.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.867[a]	2	1.433	11.871	.008
Intercept	11.468	1	11.468	94.977	.000
SampleType	2.867	2	1.433	11.871	.008
Error	.724	6	.121		
Total	15.059	9			
Corrected Total	3.591	8			

a. R Squared = .798 (Adjusted R Squared = .731)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.3029	.28372	.566	-.5676	1.1735
	substrate	-1.0167*	.28372	.027	-1.8872	-.1461
residues	larvae/pupae	-.3029	.28372	.566	-1.1735	.5676
	substrate	-1.3196*	.28372	.008	-2.1901	-.4491
substrate	larvae/pupae	1.0167*	.28372	.027	.1461	1.8872
	residues	1.3196*	.28372	.008	.4491	2.1901

Based on observed means.

The error term is Mean Square(Error) = .121.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.014[a]	2	.007	68.755	.000
Intercept	.037	1	.037	367.006	.000
SampleType	.014	2	.007	68.755	.000
Error	.001	6	9.964E-5		
Total	.051	9			
Corrected Total	.014	8			

a. R Squared = .958 (Adjusted R Squared = .944)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0881*	.00815	.000	-.1131	-.0631
	substrate	-.0761*	.00815	.000	-.1011	-.0511
residues	larvae/pupae	.0881*	.00815	.000	.0631	.1131
	substrate	.0120	.00815	.367	-.0130	.0370
substrate	larvae/pupae	.0761*	.00815	.000	.0511	.1011
	residues	-.0120	.00815	.367	-.0370	.0130

Based on observed means.

The error term is Mean Square(Error) = 9.96E-005.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.000[a]	2	9.898E-5	8.908	.016
Intercept	.002	1	.002	174.208	.000
SampleType	.000	2	9.898E-5	8.908	.016
Error	6.667E-5	6	1.111E-5		
Total	.002	9			
Corrected Total	.000	8			

a. R Squared = .748 (Adjusted R Squared = .664)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.0055	.00272	.187	-.0139	.0028
	substrate	-.0115*	.00272	.013	-.0198	-.0031
residues	larvae/pupae	.0055	.00272	.187	-.0028	.0139
	substrate	-.0060	.00272	.151	-.0143	.0024
substrate	larvae/pupae	.0115*	.00272	.013	.0031	.0198
	residues	.0060	.00272	.151	-.0024	.0143

Based on observed means.

The error term is Mean Square(Error) = 1.11E-005.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Al

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	94.194[a]	2	47.097	5.172	.049
Intercept	106.619	1	106.619	11.708	.014
SampleType	94.194	2	47.097	5.172	.049
Error	54.641	6	9.107		
Total	255.454	9			
Corrected Total	148.835	8			

a. R Squared = .633 (Adjusted R Squared = .510)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Al

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.9543	2.46399	.922	-8.5145	6.6059
	substrate	-7.2899	2.46399	.057	-14.8501	.2703
residues	larvae/pupae	.9543	2.46399	.922	-6.6059	8.5145
	substrate	-6.3356	2.46399	.093	-13.8958	1.2246
substrate	larvae/pupae	7.2899	2.46399	.057	-.2703	14.8501
	residues	6.3356	2.46399	.093	-1.2246	13.8958

Based on observed means.

The error term is Mean Square(Error) = 9.107.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Cr

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.031[a]	2	.016	27.796	.001
Intercept	.045	1	.045	80.242	.000
SampleType	.031	2	.016	27.796	.001
Error	.003	6	.001		
Total	.079	9			
Corrected Total	.034	8			

a. R Squared = .903 (Adjusted R Squared = .870)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Cr

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0441	.01930	.135	-.1033	.0151
	substrate	-.1406*	.01930	.001	-.1998	-.0814
residues	larvae/pupae	.0441	.01930	.135	-.0151	.1033
	substrate	-.0966*	.01930	.006	-.1558	-.0374
substrate	larvae/pupae	.1406*	.01930	.001	.0814	.1998
	residues	.0966*	.01930	.006	.0374	.1558

Based on observed means.

The error term is Mean Square(Error) = .001.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Mn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	8.511[a]	2	4.256	3.857	.084
Intercept	154.730	1	154.730	140.218	.000
SampleType	8.511	2	4.256	3.857	.084
Error	6.621	6	1.103		
Total	169.862	9			
Corrected Total	15.132	8			

a. R Squared = .562 (Adjusted R Squared = .417)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Mn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.6610	.85771	.733	-1.9707	3.2927
	substrate	-1.6514	.85771	.212	-4.2831	.9803
residues	larvae/pupae	-.6610	.85771	.733	-3.2927	1.9707
	substrate	-2.3124	.85771	.080	-4.9441	.3193
substrate	larvae/pupae	1.6514	.85771	.212	-.9803	4.2831
	residues	2.3124	.85771	.080	-.3193	4.9441

Based on observed means.

The error term is Mean Square(Error) = 1.103.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Fe

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1548.662[a]	2	774.331	12.832	.007
Intercept	1322.374	1	1322.374	21.914	.003
SampleType	1548.662	2	774.331	12.832	.007
Error	362.056	6	60.343		
Total	3233.092	9			
Corrected Total	1910.717	8			

a. R Squared = .811 (Adjusted R Squared = .747)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Fe

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-3.2730	6.34259	.867	-22.7338	16.1878
	substrate	-29.3186*	6.34259	.009	-48.7794	-9.8578
residues	larvae/pupae	3.2730	6.34259	.867	-16.1878	22.7338
	substrate	-26.0455*	6.34259	.015	-45.5063	-6.5847
substrate	larvae/pupae	29.3186*	6.34259	.009	9.8578	48.7794
	residues	26.0455*	6.34259	.015	6.5847	45.5063

Based on observed means.

The error term is Mean Square(Error) = 60.343.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Co

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.015[a]	2	.008	57.568	.000
Intercept	.039	1	.039	295.781	.000
SampleType	.015	2	.008	57.568	.000
Error	.001	6	.000		
Total	.055	9			
Corrected Total	.016	8			

a. R Squared = .950 (Adjusted R Squared = .934)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Co

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0753*	.00941	.000	-.1042	-.0464
	substrate	-.0959*	.00941	.000	-.1248	-.0670
residues	larvae/pupae	.0753*	.00941	.000	.0464	.1042
	substrate	-.0206	.00941	.152	-.0495	.0083
substrate	larvae/pupae	.0959*	.00941	.000	.0670	.1248
	residues	.0206	.00941	.152	-.0083	.0495

Based on observed means.

The error term is Mean Square(Error) = .000.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Ni

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.780[a]	2	.390	80.741	.000
Intercept	.831	1	.831	172.000	.000
SampleType	.780	2	.390	80.741	.000
Error	.029	6	.005		
Total	1.639	9			
Corrected Total	.809	8			

a. R Squared = .964 (Adjusted R Squared = .952)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Ni

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.1862*	.05674	.039	-.3603	-.0121
	substrate	-.6963*	.05674	.000	-.8704	-.5223
residues	larvae/pupae	.1862*	.05674	.039	.0121	.3603
	substrate	-.5101*	.05674	.000	-.6842	-.3361
substrate	larvae/pupae	.6963*	.05674	.000	.5223	.8704
	residues	.5101*	.05674	.000	.3361	.6842

Based on observed means.

The error term is Mean Square(Error) = .005.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Cu

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	281.947[a]	2	140.973	54.852	.000
Intercept	272.186	1	272.186	105.906	.000
SampleType	281.947	2	140.973	54.852	.000
Error	15.420	6	2.570		
Total	569.553	9			
Corrected Total	297.367	8			

a. R Squared = .948 (Adjusted R Squared = .931)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Cu

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-2.1818	1.30896	.292	-6.1981	1.8344
	substrate	-12.8128*	1.30896	.000	-16.8291	-8.7966
residues	larvae/pupae	2.1818	1.30896	.292	-1.8344	6.1981
	substrate	-10.6310*	1.30896	.000	-14.6472	-6.6147
substrate	larvae/pupae	12.8128*	1.30896	.000	8.7966	16.8291
	residues	10.6310*	1.30896	.000	6.6147	14.6472

Based on observed means.

The error term is Mean Square(Error) = 2.570.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Zn

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	429.645[a]	2	214.823	62.696	.000
Intercept	342.882	1	342.882	100.071	.000
SampleType	429.645	2	214.823	62.696	.000
Error	20.558	6	3.426		
Total	793.086	9			
Corrected Total	450.204	8			

a. R Squared = .954 (Adjusted R Squared = .939)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Zn

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0386	1.51138	1.000	-4.6760	4.5987
	substrate	-14.6761*	1.51138	.000	-19.3134	-10.0388
residues	larvae/pupae	.0386	1.51138	1.000	-4.5987	4.6760
	substrate	-14.6375*	1.51138	.000	-19.2748	-10.0002
substrate	larvae/pupae	14.6761*	1.51138	.000	10.0388	19.3134
	residues	14.6375*	1.51138	.000	10.0002	19.2748

Based on observed means.

The error term is Mean Square(Error) = 3.426.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - As

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.238[a]	2	.119	108.180	.000
Intercept	.499	1	.499	453.676	.000
SampleType	.238	2	.119	108.180	.000
Error	.007	6	.001		
Total	.743	9			
Corrected Total	.245	8			

a. R Squared = .973 (Adjusted R Squared = .964)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - As

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	-.3807*	.02708	.000	-.4638	-.2976
	substrate	-.2917*	.02708	.000	-.3747	-.2086
residues	larvae/pupae	.3807*	.02708	.000	.2976	.4638
	substrate	.0890*	.02708	.038	.0059	.1721
substrate	larvae/pupae	.2917*	.02708	.000	.2086	.3747
	residues	-.0890*	.02708	.038	-.1721	-.0059

Based on observed means.

The error term is Mean Square(Error) = .001.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Cd

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4.142E-5[a]	2	2.071E-5	2.535	.159
Intercept	.001	1	.001	121.840	.000
SampleType	4.142E-5	2	2.071E-5	2.535	.159
Error	4.902E-5	6	8.170E-6		
Total	.001	9			
Corrected Total	9.044E-5	8			

a. R Squared = .458 (Adjusted R Squared = .277)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Cd

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	.0000	.00233	1.000	-.0072	.0072
	substrate	-.0046	.00233	.205	-.0117	.0026
residues	larvae/pupae	.0000	.00233	1.000	-.0072	.0072
	substrate	-.0046	.00233	.205	-.0117	.0026
substrate	larvae/pupae	.0046	.00233	.205	-.0026	.0117
	residues	.0046	.00233	.205	-.0026	.0117

Based on observed means.

The error term is Mean Square(Error) = 8.17E-006.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran - Pb

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.006[a]	2	.003	3.041	.122
Intercept	.009	1	.009	8.848	.025
SampleType	.006	2	.003	3.041	.122
Error	.006	6	.001		
Total	.022	9			
Corrected Total	.013	8			

a. R Squared = .503 (Adjusted R Squared = .338)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Pb

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	-.0089	.02643	.940	-.0900	.0722
	substrate	-.0604	.02643	.134	-.1415	.0207
residues	larvae/pupae	.0089	.02643	.940	-.0722	.0900
	substrate	-.0515	.02643	.206	-.1326	.0296
substrate	larvae/pupae	.0604	.02643	.134	-.0207	.1415
	residues	.0515	.02643	.206	-.0296	.1326

Based on observed means.

The error term is Mean Square(Error) = .001.

Appendix D – Carbon and Nitrogen Statistical Analyses

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran – Carbon (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	354.709[a]	2	177.354	790.193	.000
Intercept	18162.054	1	18162.054	80920.045	.000
SampleType	354.709	2	177.354	790.193	.000
Error	1.347	6	.224		
Total	18518.110	9			
Corrected Total	356.056	8			

a. R Squared = .996 (Adjusted R Squared = .995)

Multiple Comparisons

Dependent Variable: Wheat Bran – Carbon (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	15.0000*	.38682	.000	13.8131	16.1869
	substrate	10.4333*	.38682	.000	9.2465	11.6202
residues	larvae/pupae	-15.0000*	.38682	.000	-16.1869	-13.8131
	substrate	-4.5667*	.38682	.000	-5.7535	-3.3798
substrate	larvae/pupae	-10.4333*	.38682	.000	-11.6202	-9.2465
	residues	4.5667*	.38682	.000	3.3798	5.7535

Based on observed means.

The error term is Mean Square(Error) = .224.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran – Nitrogen (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	67.539[a]	2	33.769	2580.006	.000
Intercept	152.934	1	152.934	11684.295	.000
SampleType	67.539	2	33.769	2580.006	.000
Error	.079	6	.013		
Total	220.552	9			
Corrected Total	67.617	8			

a. R Squared = .999 (Adjusted R Squared = .998)

Multiple Comparisons

Dependent Variable: Wheat Bran – Nitrogen (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	6.2967*	.09341	.000	6.0101	6.5833
	substrate	5.1567*	.09341	.000	4.8701	5.4433
residues	larvae/pupae	-6.2967*	.09341	.000	-6.5833	-6.0101
	substrate	-1.1400*	.09341	.000	-1.4266	-.8534
substrate	larvae/pupae	-5.1567*	.09341	.000	-5.4433	-4.8701
	residues	1.1400*	.09341	.000	.8534	1.4266

Based on observed means.

The error term is Mean Square(Error) = .013.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food – Carbon (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14.607[a]	2	7.303	6.728	.029
Intercept	15901.210	1	15901.210	14647.993	.000
SampleType	14.607	2	7.303	6.728	.029
Error	6.513	6	1.086		
Total	15922.330	9			
Corrected Total	21.120	8			

a. R Squared = .692 (Adjusted R Squared = .589)

Multiple Comparisons

Dependent Variable: Food – Carbon (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	3.0667*	.85071	.026	.4565	5.6769
	substrate	2.0333	.85071	.117	-.5769	4.6435
residues	larvae/pupae	-3.0667*	.85071	.026	-5.6769	-.4565
	substrate	-1.0333	.85071	.488	-3.6435	1.5769
substrate	larvae/pupae	-2.0333	.85071	.117	-4.6435	.5769
	residues	1.0333	.85071	.488	-1.5769	3.6435

Based on observed means.

The error term is Mean Square(Error) = 1.086.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Food – Nitrogen (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	33.607[a]	2	16.803	447.824	.000
Intercept	100.735	1	100.735	2684.667	.000
SampleType	33.607	2	16.803	447.824	.000
Error	.225	6	.038		
Total	134.567	9			
Corrected Total	33.832	8			

a. R Squared = .993 (Adjusted R Squared = .991)

Multiple Comparisons

Dependent Variable: Food – Nitrogen (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	3.7167*	.15816	.000	3.2314	4.2019
	substrate	4.3967*	.15816	.000	3.9114	4.8819
residues	larvae/pupae	-3.7167*	.15816	.000	-4.2019	-3.2314
	substrate	.6800*	.15816	.012	.1947	1.1653
substrate	larvae/pupae	-4.3967*	.15816	.000	-4.8819	-3.9114
	residues	-.6800*	.15816	.012	-1.1653	-.1947

Based on observed means.

The error term is Mean Square(Error) = .038.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 – Carbon (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	190.216[a]	2	95.108	279.729	.000
Intercept	17804.454	1	17804.454	52366.042	.000
SampleType	190.216	2	95.108	279.729	.000
Error	2.040	6	.340		
Total	17996.710	9			
Corrected Total	192.256	8			

a. R Squared = .989 (Adjusted R Squared = .986)

Multiple Comparisons

Dependent Variable: Biosolids1 – Carbon (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	11.2333*	.47610	.000	9.7725	12.6941
	substrate	4.9333*	.47610	.000	3.4725	6.3941
residues	larvae/pupae	-11.2333*	.47610	.000	-12.6941	-9.7725
	substrate	-6.3000*	.47610	.000	-7.7608	-4.8392
substrate	larvae/pupae	-4.9333*	.47610	.000	-6.3941	-3.4725
	residues	6.3000*	.47610	.000	4.8392	7.7608

Based on observed means.

The error term is Mean Square(Error) = .340.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 – Nitrogen (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11.449[a]	2	5.724	92.212	.000
Intercept	352.814	1	352.814	5683.412	.000
SampleType	11.449	2	5.724	92.212	.000
Error	.372	6	.062		
Total	364.635	9			
Corrected Total	11.821	8			

a. R Squared = .968 (Adjusted R Squared = .958)

Multiple Comparisons

Dependent Variable: Biosolids1 – Nitrogen (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	2.7533*	.20343	.000	2.1291	3.3775
	substrate	1.5733*	.20343	.001	.9491	2.1975
residues	larvae/pupae	-2.7533*	.20343	.000	-3.3775	-2.1291
	substrate	-1.1800*	.20343	.003	-1.8042	-.5558
substrate	larvae/pupae	-1.5733*	.20343	.001	-2.1975	-.9491
	residues	1.1800*	.20343	.003	.5558	1.8042

Based on observed means.

The error term is Mean Square(Error) = .062.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food – Carbon (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	96.109[a]	2	48.054	193.076	.000
Intercept	17301.018	1	17301.018	69513.018	.000
SampleType	96.109	2	48.054	193.076	.000
Error	1.493	6	.249		
Total	17398.620	9			
Corrected Total	97.602	8			

a. R Squared = .985 (Adjusted R Squared = .980)

Multiple Comparisons

Dependent Variable: Biosolids1+Food – Carbon (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	7.9000*	.40734	.000	6.6502	9.1498
	substrate	5.0667*	.40734	.000	3.8168	6.3165
residues	larvae/pupae	-7.9000*	.40734	.000	-9.1498	-6.6502
	substrate	-2.8333*	.40734	.001	-4.0832	-1.5835
substrate	larvae/pupae	-5.0667*	.40734	.000	-6.3165	-3.8168
	residues	2.8333*	.40734	.001	1.5835	4.0832

Based on observed means.

The error term is Mean Square(Error) = .249.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food – Carbon (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	96.109[a]	2	48.054	193.076	.000
Intercept	17301.018	1	17301.018	69513.018	.000
SampleType	96.109	2	48.054	193.076	.000
Error	1.493	6	.249		
Total	17398.620	9			
Corrected Total	97.602	8			

a. R Squared = .985 (Adjusted R Squared = .980)

Multiple Comparisons

Dependent Variable: Biosolids1+Food – Carbon (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	7.9000*	.40734	.000	6.6502	9.1498
	substrate	5.0667*	.40734	.000	3.8168	6.3165
residues	larvae/pupae	-7.9000*	.40734	.000	-9.1498	-6.6502
	substrate	-2.8333*	.40734	.001	-4.0832	-1.5835
substrate	larvae/pupae	-5.0667*	.40734	.000	-6.3165	-3.8168
	residues	2.8333*	.40734	.001	1.5835	4.0832

Based on observed means.

The error term is Mean Square(Error) = .249.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food – Nitrogen (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12.142[a]	2	6.071	147.599	.000
Intercept	238.600	1	238.600	5800.636	.000
SampleType	12.142	2	6.071	147.599	.000
Error	.247	6	.041		
Total	250.989	9			
Corrected Total	12.389	8			

a. R Squared = .980 (Adjusted R Squared = .973)

Multiple Comparisons

Dependent Variable: Biosolids1+Food - Nitrogen (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	2.6733*	.16560	.000	2.1652	3.1814
	substrate	2.1800*	.16560	.000	1.6719	2.6881
residues	larvae/pupae	-2.6733*	.16560	.000	-3.1814	-2.1652
	substrate	-.4933	.16560	.056	-1.0014	.0148
substrate	larvae/pupae	-2.1800*	.16560	.000	-2.6881	-1.6719
	residues	.4933	.16560	.056	-.0148	1.0014

Based on observed means.

The error term is Mean Square(Error) = .041.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran – Carbon (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	290.407[a]	2	145.203	287.215	.000
Intercept	17662.410	1	17662.410	34936.635	.000
SampleType	290.407	2	145.203	287.215	.000
Error	3.033	6	.506		
Total	17955.850	9			
Corrected Total	293.440	8			

a. R Squared = .990 (Adjusted R Squared = .986)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran – Carbon (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
larvae/pupae	residues	13.5333*	.58055	.000	11.7520	15.3146
	substrate	9.5667*	.58055	.000	7.7854	11.3480
residues	larvae/pupae	-13.5333*	.58055	.000	-15.3146	-11.7520
	substrate	-3.9667*	.58055	.001	-5.7480	-2.1854
substrate	larvae/pupae	-9.5667*	.58055	.000	-11.3480	-7.7854
	residues	3.9667*	.58055	.001	2.1854	5.7480

Based on observed means.

The error term is Mean Square(Error) = .506.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran – Nitrogen (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	56.353[a]	2	28.176	636.194	.000
Intercept	172.309	1	172.309	3890.578	.000
SampleType	56.353	2	28.176	636.194	.000
Error	.266	6	.044		
Total	228.928	9			
Corrected Total	56.618	8			

a. R Squared = .995 (Adjusted R Squared = .994)

Multiple Comparisons

Dependent Variable: Biosolids2+Wheat Bran – Nitrogen (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	5.7500*	.17183	.000	5.2228	6.2772
	substrate	4.7133*	.17183	.000	4.1861	5.2406
residues	larvae/pupae	-5.7500*	.17183	.000	-6.2772	-5.2228
	substrate	-1.0367*	.17183	.002	-1.5639	-.5094
substrate	larvae/pupae	-4.7133*	.17183	.000	-5.2406	-4.1861
	residues	1.0367*	.17183	.002	.5094	1.5639

Based on observed means.

The error term is Mean Square(Error) = .044.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran – Carbon (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	202.136[a]	2	101.068	1595.807	.000
Intercept	18288.054	1	18288.054	288758.754	.000
SampleType	202.136	2	101.068	1595.807	.000
Error	.380	6	.063		
Total	18490.570	9			
Corrected Total	202.516	8			

a. R Squared = .998 (Adjusted R Squared = .997)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran – Carbon (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	11.4667*	.20548	.000	10.8362	12.0971
	substrate	7.3000*	.20548	.000	6.6695	7.9305
residues	larvae/pupae	-11.4667*	.20548	.000	-12.0971	-10.8362
	substrate	-4.1667*	.20548	.000	-4.7971	-3.5362
substrate	larvae/pupae	-7.3000*	.20548	.000	-7.9305	-6.6695
	residues	4.1667*	.20548	.000	3.5362	4.7971

Based on observed means.

The error term is Mean Square(Error) = .063.

*. The mean difference is significant at the .05 level.

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran – Nitrogen (%) DW

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	23.690[a]	2	11.845	255.468	.000
Intercept	259.210	1	259.210	5590.439	.000
SampleType	23.690	2	11.845	255.468	.000
Error	.278	6	.046		
Total	283.179	9			
Corrected Total	23.969	8			

a. R Squared = .988 (Adjusted R Squared = .985)

Multiple Comparisons

Dependent Variable: Biosolids1+Wheat Bran - Nitrogen (%) DW

Tukey HSD

(I) SampleType	(J) SampleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
larvae/pupae	residues	3.9400*	.17582	.000	3.4005	4.4795
	substrate	2.4200*	.17582	.000	1.8805	2.9595
residues	larvae/pupae	-3.9400*	.17582	.000	-4.4795	-3.4005
	substrate	-1.5200*	.17582	.000	-2.0595	-.9805
substrate	larvae/pupae	-2.4200*	.17582	.000	-2.9595	-1.8805
	residues	1.5200*	.17582	.000	.9805	2.0595

Based on observed means.

The error term is Mean Square(Error) = .046.

*. The mean difference is significant at the .05 level.

Appendix E – NO_3^--N and NH_4^--N Statistical Analyses

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran NO3

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.282[a]	1	.282	1.432	.297
Intercept	72.802	1	72.802	370.178	.000
SampleType	.282	1	.282	1.432	.297
Error	.787	4	.197		
Total	73.870	6			
Corrected Total	1.068	5			

a. R Squared = .264 (Adjusted R Squared = .080)

Tests of Between-Subjects Effects

Dependent Variable: Wheat Bran NH4

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2676008.167[a]	1	2676008.167	68.453	.001
Intercept	3382504.167	1	3382504.167	86.525	.001
SampleType	2676008.167	1	2676008.167	68.453	.001
Error	156370.667	4	39092.667		
Total	6214883.000	6			
Corrected Total	2832378.833	5			

a. R Squared = .945 (Adjusted R Squared = .931)

Tests of Between-Subjects Effects

Dependent Variable: Food NO3

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	129.735[a]	1	129.735	522.423	.000
Intercept	401.802	1	401.802	1617.993	.000
SampleType	129.735	1	129.735	522.423	.000
Error	.993	4	.248		
Total	532.530	6			
Corrected Total	130.728	5			

a. R Squared = .992 (Adjusted R Squared = .991)

Tests of Between-Subjects Effects

Dependent Variable: Food NH4

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	21360.667[a]	1	21360.667	2.871	.165
Intercept	163350.000	1	163350.000	21.952	.009
SampleType	21360.667	1	21360.667	2.871	.165
Error	29765.333	4	7441.333		
Total	214476.000	6			
Corrected Total	51126.000	5			

a. R Squared = .418 (Adjusted R Squared = .272)

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 NO3

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.007[a]	1	.007	.039	.853
Intercept	112.667	1	112.667	656.311	.000
SampleType	.007	1	.007	.039	.853
Error	.687	4	.172		
Total	113.360	6			
Corrected Total	.693	5			

a. R Squared = .010 (Adjusted R Squared = -.238)

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1 NH4

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	39670530.667[a]	1	39670530.667	112.677	.000
Intercept	109465730.667	1	109465730.667	310.917	.000
SampleType	39670530.667	1	39670530.667	112.677	.000
Error	1408296.667	4	352074.167		
Total	150544558.000	6			
Corrected Total	41078827.333	5			

a. R Squared = .966 (Adjusted R Squared = .957)

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food NO3

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.042[a]	1	.042	.781	.427
Intercept	93.615	1	93.615	1755.281	.000
SampleType	.042	1	.042	.781	.427
Error	.213	4	.053		
Total	93.870	6			
Corrected Total	.255	5			

a. R Squared = .163 (Adjusted R Squared = -.046)

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Food NH4

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6052112.667[a]	1	6052112.667	198.324	.000
Intercept	15417654.000	1	15417654.000	505.226	.000
SampleType	6052112.667	1	6052112.667	198.324	.000
Error	122065.333	4	30516.333		
Total	21591832.000	6			
Corrected Total	6174178.000	5			

a. R Squared = .980 (Adjusted R Squared = .975)

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran NH4

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6052112.667[a]	1	6052112.667	198.324	.000
Intercept	15417654.000	1	15417654.000	505.226	.000
SampleType	6052112.667	1	6052112.667	198.324	.000
Error	122065.333	4	30516.333		
Total	21591832.000	6			
Corrected Total	6174178.000	5			

a. R Squared = .980 (Adjusted R Squared = .975)

Tests of Between-Subjects Effects

Dependent Variable: Biosolids2+Wheat Bran NH4

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3739861.500[a]	1	3739861.500	544.706	.000
Intercept	9417548.167	1	9417548.167	1371.654	.000
SampleType	3739861.500	1	3739861.500	544.706	.000
Error	27463.333	4	6865.833		
Total	13184873.000	6			
Corrected Total	3767324.833	5			

a. R Squared = .993 (Adjusted R Squared = .991)

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran NO3

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.082[a]	1	.082	.462	.534
Intercept	78.482	1	78.482	444.236	.000
SampleType	.082	1	.082	.462	.534
Error	.707	4	.177		
Total	79.270	6			
Corrected Total	.788	5			

a. R Squared = .104 (Adjusted R Squared = -.121)

Tests of Between-Subjects Effects

Dependent Variable: Biosolids1+Wheat Bran NH4

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17476266.667[a]	1	17476266.667	523.756	.000
Intercept	30717962.667	1	30717962.667	920.604	.000
SampleType	17476266.667	1	17476266.667	523.756	.000
Error	133468.667	4	33367.167		
Total	48327698.000	6			
Corrected Total	17609735.333	5			

a. R Squared = .992 (Adjusted R Squared = .991)